

**DETERMINATION OF INFRARED OPTICAL CONSTANTS FOR
SINGLE COMPONENT HYDROCARBON FUELS**

by

MICHAEL ROBERT ANDERSON

A THESIS

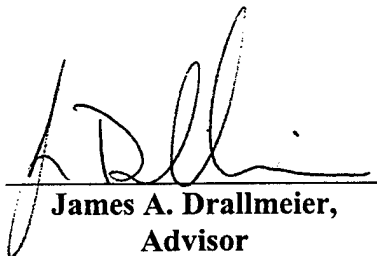
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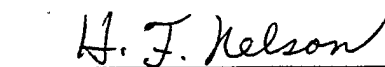
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James A. Drallmeier,
Advisor

Approved by


H. Frederick Nelson


Ralph W. Alexander, Jr.

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ABSTRACT

The objective of this investigation was to develop an experiment that could determine the infrared optical constants of single component hydrocarbon fuels from 2-15 μm (5000 – 667 cm^{-1}). The optical constants to be determined were the Lambert coefficient of absorption and the real and imaginary parts of the complex index of refraction. The coefficient of absorption and the imaginary part of the index of refraction (extinction coefficient) were determined directly from transmittance measurements. The real part of the index of refraction (refractive index) was calculated using the absorption coefficient and Kramers-Kronig optical dispersion relations. Since Kramers-Kronig relations require knowledge of the absorption coefficient across the entire spectrum of frequencies (wave numbers 0 to ∞), assumptions about the behavior of the absorption coefficient were modeled from existing transmittance data outside the experimental region.

Optical constants were determined for nine single component liquid hydrocarbon fuels. The fuels investigated were: iso-octane, iso-pentane, n-heptane, n-hexane, n-nonane, n-decane, 1-hexene, o-xylene, and toluene. Because of the availability of accurate published data, water was used to validate the experimental set-up.

The determined absorption coefficient curve for iso-octane showed excellent agreement with the absorption coefficient curve produced from American Petroleum Institute (API) data. Additionally, the calculated value for the absorption coefficient and extinction coefficient for iso-octane at 3.39 μm (2950 cm^{-1}) is in very good agreement with existing results from reflectance measurements.

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NOMENCLATURE

N	complex index of refraction
n	real part of the complex index of refraction
$n(\omega)$	real part of the complex index of refraction at frequency, ω
$n(\omega_0)$	real part of the complex index of refraction at frequency, ω_0
$n(\omega_m)$	real part of the complex index of refraction at reference frequency, ω_m
$\Delta_{UVn}(\omega_0)$	contribution to the real part of the complex index of refraction from ultraviolet absorption
i	imaginary number
k	imaginary part of the complex index of refraction
$k(\omega)$	imaginary part of the complex index of refraction at frequency, ω
$k(\omega_0)$	imaginary part of the complex index of refraction at frequency, ω_0
ω	angular frequency in wave numbers, cm^{-1}
ω_m	reference angular frequency in wave numbers, cm^{-1}
ω_L	frequency at the start of the experimental data range
ω_U	frequency at the end of the experimental data range
ω_j	frequency at the j th experimental data point
ω_{j+1}	frequency at the $j+1$ experimental data point
ω_{j-1}	frequency at the $j-1$ experimental data point
α	Lambert Coefficient of Absorption
$\alpha(\omega)$	Lambert Coefficient of Absorption at frequency, ω
$\alpha(\omega_0)$	Lambert Coefficient of Absorption at frequency, ω_0
$\alpha(\omega_L)$	Lambert Coefficient of Absorption at frequency, ω_L

$\alpha(\omega_U)$	Lambert Coefficient of Absorption at frequency, ω_U
$\alpha(\omega_m)$	Lambert Coefficient of Absorption at some reference frequency, ω_m
$\alpha'(\omega)$	first derivative of the absorption data at frequency, ω
α_j	absorption coefficient at the frequency of the j th experimental data point
α_{j+1}	absorption coefficient at the frequency of the $j+1$ experimental data point
α_{j-1}	absorption coefficient at the frequency of the $j-1$ experimental data point
$I(\omega)$	radiant intensity at frequency ω through the sample filled cell
$I_0(\omega)$	radiant intensity at frequency ω through the empty cell
R_0	air-glass reflectance from the empty cell
R	fluid-glass reflectance from the filled cell
x	cell thickness
$T_{em}(\omega)$	experimentally measured transmittance at frequency, ω
λ	wavelength of light in μm (microns)
P	principal part of the Cauchy Integral
C	contour used in Cauchy Integral
C_1-C_4	contours one through four used in Cauchy Integral
c	speed of light
v	velocity
$f(z)$	arbitrary complex function
$u(z)$	real part of the complex function, $f(z)$
$v(z)$	imaginary part of the complex function, $f(z)$
$\Re[f(z)]$	real part of the complex function, $f(z)$
$\Im[f(z)]$	imaginary part of the complex function, $f(z)$

δ	displacement
nd	number of experimental data points
F_j	value of the integrand at data point j
F_{j+1}	value of the integrand at data point $j+1$
$r(\omega)$	complex reflection coefficient at frequency ω
$r(\omega_0)$	complex reflection coefficient at frequency ω_0
$r^*(\omega)$	complex conjugate of the complex reflection coefficient at frequency ω
$f^*(z)$	complex conjugate of the function, $f(z)$
$\theta_r(\omega)$	phase at frequency ω
$\theta_r(\omega_0)$	phase at frequency ω_0
$\theta_r(\omega_m)$	phase at frequency ω_m

1. INTRODUCTION

Infrared extinction is a current popular method for the quantitative measurement of fuel-vapor concentration in fuel sprays. These measurements yield a better understanding of fuel spray characteristics which will lead to improvements in fuel spray systems and improvements in the combustion process, e.g., better emissions control. Drallmeier [1, 2], Billings and Drallmeier [3], and Luke [4] have performed detailed investigations into the feasibility of using the infrared extinction technique as a non-intrusive means of analyzing fuel-vapor concentrations. Critical to the infrared extinction technique is the calculation of the fuel droplet optical thickness. Given the refractive index, Mie Scattering Theory will predict droplet cross-section at a given wavelength as a function of drop size. However, published data for the complex index of refraction of hydrocarbon fuels in the infrared is very limited. Drallmeier and Peters [5] determined the complex index of refraction for iso-octane, but that was done at one specific wavelength, $3.39 \mu\text{m}$ (2950 cm^{-1}). Alexander et al. [6] determined the complex index of refraction of liquid RP-1 rocket fuel at eight specific laser wavelengths varying from $0.193 \mu\text{m}$ (51813 cm^{-1}) to $10.5915 \mu\text{m}$ (944 cm^{-1}). Neither of these investigations determined optical properties over a continuous spectrum.

The goal of this investigation was to experimentally determine the complex index of refraction for nine single component hydrocarbon fuels over a broad infrared spectrum. Six paraffin (alkane), one olefin (alkene), and two aromatic (alkyl benzenes) hydrocarbon fuels were studied. These fuels were: paraffin; iso-pentane, C_5H_{12} , iso-octane, C_8H_{18} , n-hexane, C_6H_{14} , n-heptane, C_7H_{16} , n-nonane, C_9H_{20} , and n-decane, $\text{C}_{10}\text{H}_{22}$, olefin; 1-hexene, C_6H_{12} , and aromatic; toluene, C_7H_8 , o-xylene, C_8H_{10} .

A review of current literature is presented in Section 2. Methods of determining the complex index of refraction for water and other substances were examined in this section. Section 2 also provides a detailed discussion on the derivation of the Kramers-Kronig optical dispersion relations used to determine the real and imaginary parts of the index of refraction. Additionally, the method for evaluating these dispersion relations is presented. A description of the experimental set-up used and procedure used is given in Section 3. Section 4 presents the validation of the experimental set-up. The results of the experiment using the hydrocarbon fuels are presented and discussed in Section 5. Conclusions and recommendations are made in Section 6. Appendix A is a listing of the computer codes used to implement the Kramers-Kronig relations to calculate the real part of the index of refraction and the codes used to acquire and reduce the experimental data. Appendix B contains the exact experimental procedure used and Appendix C contains the tables of the experimentally determined optical constants for each of the nine fuels.

2. LITERATURE REVIEW

2.1 METHODS OF DETERMINING INFRARED OPTICAL CONSTANTS

There are many different ways to experimentally determine optical constants of a substance in the infrared spectral region. These experimental methods require a variety of either transmittance and/or reflectance measurements in order to calculate the desired optical constant. The optical constants that are of most interest are the complex index of refraction, N , the real and imaginary parts of the index of refraction, n and k , and the Lambert Absorption Coefficient, α . The following relations define these constants:

$$N = n - ik \quad (1)$$

where i is an imaginary number that is defined as $i = \sqrt{-1}$ and

$$\alpha = \frac{4\pi k}{\lambda} \quad (2)$$

where λ is the wavelength of the light. Transmittance measurements are most commonly used to determine the imaginary part, k , of the index of refraction and the absorption coefficient, α . Transmittance and reflectance measurements can both be used to calculate the real part of the index of refraction.

Some researchers sought only to determine the optical properties of a substance at a specific wavelength. Drallmeier [5] used a two-angle reflection approach that measured the ratio of the parallel reflectance to the perpendicular reflectance to determine the index of refraction of iso-octane at $3.39 \mu\text{m}$ (2950 cm^{-1}). This approach is limited to spectral regions where the substance is strongly absorbing. The method will produce large errors in spectral region of small absorption, i.e., when the extinction coefficient (imaginary part of the index of refraction) is ≤ 0.01 . Alexander et al. [6] employed four

different methods to determine the real part, n , of the index of refraction at eight different laser wavelengths. They used reflectance measurements, critical-angle measurements, Mueller matrix elements from scatterometer measurements, and Michelson interferometer measurements. A scatterometer was used instead of an ellipsometer since it determines all 16 elements of the Mueller matrix versus four by an ellipsometer. The investigators used these different methods because of the large changes of the extinction coefficient over the wavelengths investigated. The extinction coefficient, k , was determined from transmittance measurements using a spectrophotometer. The obvious disadvantages to this procedure are the number of different experimental setups and the inability to determine the optical constants over a broad spectral region.

In order to determine optical constants over a broad spectral region, transmittance and/or reflection measurements must be made over that broad region. A variety of mathematical methods can then be applied to the spectral data to determine the optical constants. The Optical Society of America organized a symposium in 1983 [7] to discuss various methods of determining optical constants of thin films. The panel of experts sought to determine the optical constants of two thin film materials all by different methods. The various panelists performed the measurements at seven different research laboratories and the results were compiled by Dobrowolski et al. [7]. Reflectance and transmittance measurements were made with a variety of spectrophotometers and ellipsometers. The investigators then used different iterative mathematical algorithms to converge on solutions for n and k . The spectral range was 400-900 nm (the visible to near infrared, NIR, range). Aside from many of the mathematical methods being quite complicated, some methods did not converge to a solution. The study highlights the

difficulty in determining optical constants over a broad spectrum and the inability of some reflection techniques to accurately determine the extinction coefficient.

Palik [8] and Macleod [9] describe some of the more popular techniques utilized to determine optical constants and the associated advantages and disadvantages of each. One method for determining optical constants for liquids over a broad spectral range is to utilize Kramers-Kronig optical dispersion relations to determine n and k from either transmittance or reflectance measurements. The Kramers-Kronig method was chosen for this investigation because 1) it provide accurate results over a broad spectral region that has both strong absorption and transmittance and 2) the mathematics behind the method is straightforward. Additionally, many different researchers have used this method to accurately determine optical constants of a variety of different substances. A large amount of experimental work on determining the optical constants of water using the Kramers-Kronig method has been performed. Further investigation into this research was made in order to develop an experimental setup that could use water as a test substance to validate the experiment.

2.2 DETERMINING OPTICAL CONSTANTS OF WATER

In 1968, Irvine and Pollack [10] completed an exhaustive review of to-date published optical properties of water and ice and critically examined the accuracy of the reported results. They did this because many of the reports had data that was extremely contradictory to each other. The largest uncertainties centered on the determination of the Lambert Absorption Coefficient, α , from experimental transmittance data. The absorption spectrum is generally found by measuring the transmittance through an empty

cell and then comparing it to the transmittance through a cell filled with a sample. The absorption coefficient is found from

$$(1 - R_o)I_o(\omega) = (1 - R)I(\omega)e^{-\alpha x} \quad (3)$$

where $(1-R)I(\omega)$ is the fraction of the radiation intensity transmitted through the cell at frequency, ω , x is the cell thickness and $(1-R_o)I_o$ is the intensity of the radiation through the empty cell. Most researchers assume $R_o = R$. This assumption is technically incorrect since the reflectance, R_o , of the air-glass boundary will differ from the reflectance of the sample-glass boundary, R . Irvine and Pollack [10] stated that since the difference between R and R_o is generally quite small, the induced error would make little difference. However, in regions where transmittance is near 100%, a small error in reflection loss can lead to a large error in the calculated absorption coefficient.

They also cited problems encountered when α is quite large, e.g., in the center of strong absorption bands. A very small cell thickness must be used. Errors can be introduced when the cell thickness is less than 10 μm . For example, curvature in the cell boundaries causes errors in the true determination of the cell thickness. A very small change in x can lead to a large change in α . They encouraged future investigators to use multiple thicknesses so that the transmittance values do not move too far toward either extreme (100% or 0% transmittance). Low transmittance is not bad, as long as it is measured accurately. Also, in regions of rapidly changing α as a function of wavelength, researchers must have sufficient spectral resolution. Multiple investigations [11-15] produced satisfactory results with a spectral resolution in wavenumbers of $\leq 10 \text{ cm}^{-1}$.

Draeger et al. [16], investigated the far-infrared spectrum of water using multiple cell materials to cover the range of 2.5-330 μm (4000-30.3 cm^{-1}). They developed a

logarithmic relation to determine α at various frequencies in order to account for the error in assuming the empty cell and filled cell reflectance is equal. Since the transmitted intensities are $(1-R_o)I_o(\omega)$ for the empty cell and $(1-R)I(\omega)$ for the filled cell (where R_o and R may not be equal because of reflections), the experimentally measured fractional transmittance, T_{em} , is given by

$$T_{em}(\omega) = \frac{[1-R]I(\omega)}{[1-R_o]I_o(\omega)} = e^{-\alpha(\omega)x} \quad (4)$$

as opposed to the true fractional transmittance which is just the ratio of the intensities.

From this, the logarithmic relation

$$\ln T_{em}(\omega) = \ln \left[\frac{1-R}{1-R_o} \right] - \alpha(\omega)x \quad (5)$$

can be used to determine $\alpha(\omega)$ at various frequencies. Draeger et al. [16] determined $\alpha(\omega)$ from the slope of the $\ln T_{em}(\omega)$ versus x curve. The curve is a straight line produced from a least square fit of transmittance measurements of different thicknesses taken at the same frequency. The logarithm of the reflection ratios is given by the intercept of the line at $x = 0$. They found in most cases that the intercept was very small, thus, showing that the two reflections were nearly equal. However, they used the correction term to calculate the absorption coefficient.

Robertson and Williams [17] employed a similar technique as Draeger et al. [16] for determining the absorption coefficient of water in the range of 2.22-33.3 μm (4500 to 300 cm^{-1}). They used a variable length cell in a spectrophotometer to determine the transmittance. An equivalent method to Draeger et al. [16] is to determine the absorption coefficient from the ratio of the transmittances at two different cell thickness, x_1 and x_2 .

$$\frac{T_2}{T_1} = e^{-\alpha(x_2-x_1)} \quad (6)$$

This method will also eliminate the effect of the reflectance from the cell windows. This method is limited by the ability to establish and measure discrete differences in film thickness.

The imaginary part, k , of the index of refraction was calculated from equation (3),

$$k = \frac{\lambda\alpha}{4\pi} \quad (7)$$

after the absorption coefficient, α , was determined. Robertson and Williams [17] point out that equations (3) and (5) apply very strictly to a parallel beam moving through the sample cell. They used a non-parallel beam, but since the extreme rays of their convergent beam only made an eight-degree angle with the central ray, they ignored the small error induced into the cell path length.

Bertie et al. [11] used transmittance data to determine the absorptivity of ice in the frequency range of 2.5-333.3 μm (4000 to 30 cm^{-1}). In addition to calculating α and k , they employed a Kramers-Kronig optical dispersion relation to determine the real part, n , of the complex index of refraction. This relation is given by

$$n(\omega_0) = 1 + \frac{1}{2\pi^2} P \int_0^\infty \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega. \quad (8)$$

A detailed analysis for the use of this equation is given in the next section. In order to use the Kramers-Kronig relationship, knowledge of the transmittance or reflectance across the entire spectrum, not just over the experimental range is required. When employing this technique, certain assumptions can be made to account for the spectrum outside of the experimental data range. In these regions, the absorption coefficient can be

assumed to be zero or a constant. Bertie et al. [11] showed that the Kramers-Kronig technique is relatively insensitive to either assumption, but that more error can be introduced when numerically integrating. These errors centered on regions where the absorption coefficient was rapidly changing. This error is greatly minimized if enough resolution is achieved between data points. All of these errors, however were insignificant compared to the error introduced by the experimental methods used in determining the absorption curve.

Palmer and Williams [18] determined the optical properties of water in the near infrared using both transmittance and reflectance measurements. They used cell path lengths that varied from 50 mm to 30 μm . In regions of strong absorption, i.e., frequencies below 4000 cm^{-1} ($2.5\text{ }\mu\text{m}$), the cells used in their investigation were too thick to accurately determine α . They recommended using smaller path lengths or employing other methods to determine the real and imaginary parts of the index of refraction in that region.

Rusk et al. [19] and Querry et al. [20] used reflectance measurements to determine the optical constants of water in the infrared. Both studies concluded that reflectance measurements provide an accurate determination of the real part of the index of refraction. In regions of strong absorption, reflectance measurements provide more accurate values of the imaginary part of the index of refraction. This conclusion was based on the difficulties in preparing extremely thin absorption cells and the capability to measure low transmittance values accurately. Both studies presented their results for water using values calculated from transmittance data (in areas of weak absorption) from previous investigations and reflectance data (in areas of strong absorption).

In 1975 Downing and Williams [12] published another comprehensive study of all previous work done in the field of determining the optical constants of water in the infrared. In a manner similar to Irvine and Pollack [10], they list the constants for water in the frequency range of 2-1000 μm (5000 to 10 cm^{-1}). In 1981, Segelstein [21] completed a comprehensive collection of the extinction coefficient of water in the frequency range of 10^6 to $10^{-3}\text{ }\mu\text{m}$ (10^{-3} to 10^6 cm^{-1}). Because of the resolution in data points that was published by Downing and Williams [12], and the close agreement with Segelstein [21], their data is used as accepted values in this investigation. This data was also used to develop the computer code to calculate the real part of the index of refraction from the Kramers-Kronig optical dispersion relations.

2.3 KRAMERS-KRONIG OPTICAL DISPERSION RELATIONS

Before proceeding with a further review of existing literature on the determination of optical constants, a detailed derivation of the Kramers-Kronig optical dispersion relations is required. As stated in the preceding section, determining the Lambert Coefficient of Absorption and the imaginary part of the complex index of refraction from transmittance measurements is relatively straightforward using equations (3) – (7). Determining the real part of the index of refraction from the Kramers-Kronig dispersion relations is more complicated. In this section, the Kramers-Kronig relation for calculating the real part of the index of refraction from transmittance measurements is presented. Following this section, derivations of the Kramers-Kronig relations for reflectance measurements and the Subtractive Kramers-Kronig method for both transmittance and reflectance are made.

The following derivation of the Kramers-Kronig relations is taken from Arfken and Webber [22], Wootton [23] and work done by Tucker [24] and Newquist [25]. The term dispersion relation comes from optical dispersion, the fact that the index of refraction is dependent on the wavelength of light. In 1926-1927, Kramers and Kronig showed that the real part of the index of refraction could be expressed as an integral of the imaginary part.

Consider the function $f(z)$, which is complex and analytic over the contour C , an infinite semi-circle, shown in Figure 2.1. In Figure 2.1, the x -axis is the real axis and the y -axis is the imaginary axis. If a function is analytic, it is differentiable at every point within the contour. The Cauchy Integral Theorem [26] states that for an analytic function, $f(z)$

$$\oint_C f(z) dz = 0 \quad (9)$$

where z is any point located on the interior of the closed contour, C . The rotation about the contour is assumed to be in the counter-clockwise direction. The Cauchy Integral Formula [26] states

$$f(z_0) = \frac{1}{2\pi i} \oint_C \frac{f(z)}{z - z_0} dz \quad (10)$$

where C is the closed contour about z_0 and z is on C . If $f(z)/(z-z_0)$ is also analytic, then it is differentiable at every point except where $z = z_0$. In order to exclude this point, the contour, C_3 is used. Using the Cauchy Integral Theorem, the integral is

$$\left[\oint_{c_1} \frac{f(z)}{z - z_0} dz + \oint_{c_2} \frac{f(z)}{z - z_0} dz + \oint_{c_3} \frac{f(z)}{z - z_0} dz + \oint_{c_4} \frac{f(z)}{z - z_0} dz \right] = 0. \quad (11)$$

In order for the integral over the infinite semi-circle, C_1 , to vanish, the following condition is applied

$$\lim_{|z| \rightarrow \infty} |f(z)| = 0 \quad 0 \leq \arg(z) \leq \pi. \quad (12)$$

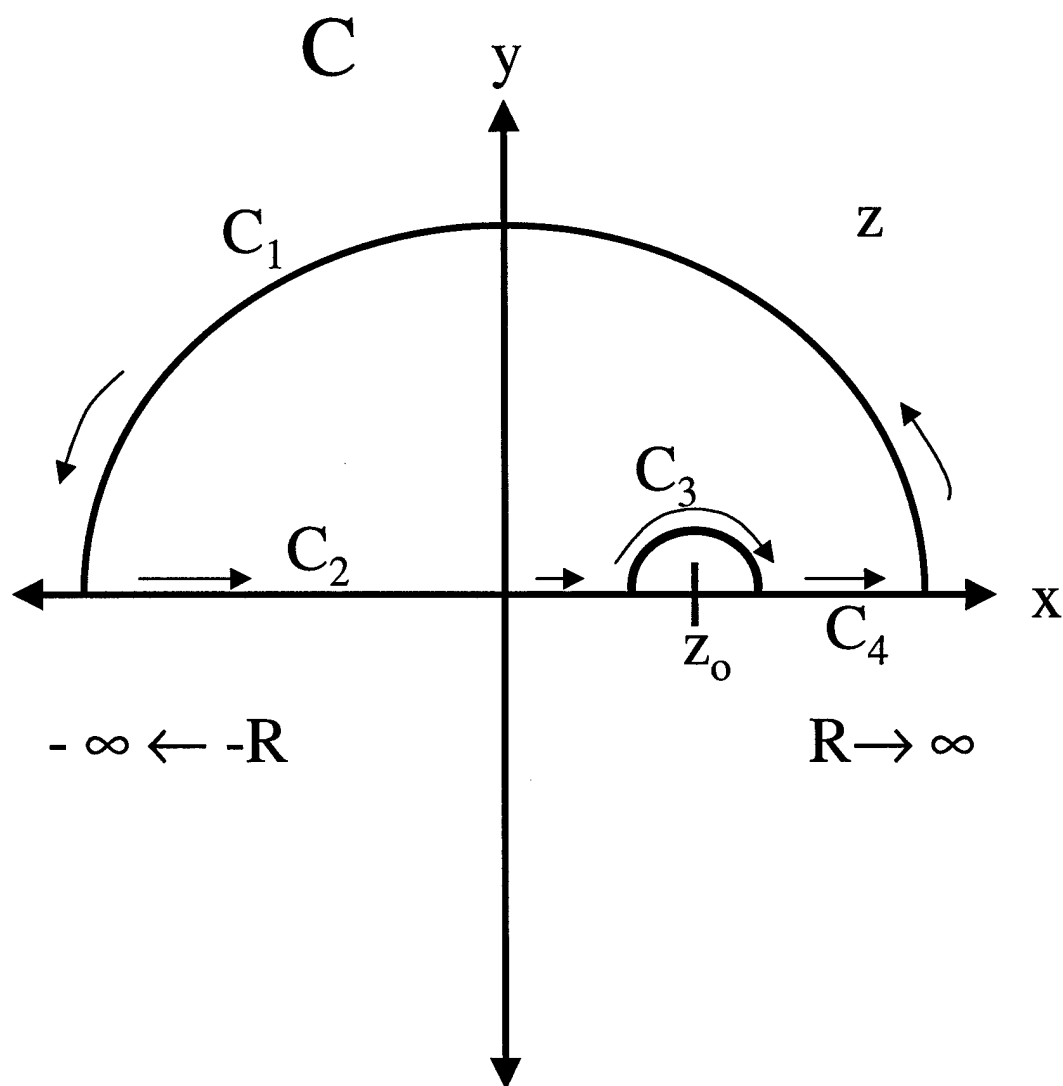


Figure 2.1 Contour C used for Kramers-Kronig derivation

Equation (11) now becomes

$$\left[\int_{-\infty}^{x-\delta} \frac{f(z)}{z-z_0} dz + \int_{x+\delta}^{\infty} \frac{f(z)}{z-z_0} dz \right] = - \oint_{C_3} \frac{f(z)}{z-z_0} dz \quad (12)$$

where δ is a small displacement on either side of z_0 . Applying the Cauchy Integral

Formula to contour C_3 yields

$$f(z_0) = -\frac{1}{\pi i} \oint_{C_3} \frac{f(z)}{z-z_0} dz. \quad (14)$$

This is only half of the value given by the Integral Formula since C_3 is a semi-circle. It is negative since the integral is taken in the clockwise direction, as indicated in Figure 2.1.

Combining equations (13) and (14) yields

$$f(z_0) = \frac{1}{\pi i} \left[\int_{-\infty}^{x-\delta} \frac{f(z)}{z-z_0} dz + \int_{x+\delta}^{\infty} \frac{f(z)}{z-z_0} dz \right]. \quad (15)$$

As δ approaches zero

$$f(z_0) = \frac{1}{\pi i} P \int_{-\infty}^{\infty} \frac{f(z)}{z-z_0} dz \quad (16)$$

where P indicates the Cauchy principal value and is defined as

$$P \int_{-\infty}^{\infty} \frac{f(z)}{z-z_0} dz = \lim_{\delta \rightarrow 0} \left(\int_{-\infty}^{x-\delta} \frac{f(z)}{z-z_0} dz + \int_{x+\delta}^{\infty} \frac{f(z)}{z-z_0} dz \right). \quad (17)$$

Splitting equation (16) into real and imaginary parts results in

$$f(z_0) = u(z_0) + iv(z_0) = \frac{1}{\pi} P \int_{-\infty}^{\infty} \frac{v(z)}{z-z_0} dz - \frac{i}{\pi} P \int_{-\infty}^{\infty} \frac{u(z)}{z-z_0} dz. \quad (18)$$

Equating real part to real part and imaginary part to imaginary part

$$u(z_0) = \frac{1}{\pi} P \int_{-\infty}^{\infty} \frac{v(z)}{z-z_0} dz \quad (19)$$

$$v(z_0) = -\frac{1}{\pi} P \int_{-\infty}^{\infty} \frac{u(z)}{z - z_0} dz \quad (20)$$

which are the dispersion relations. The real part of the complex function is expressed as an integral of the imaginary part and vice-versa. The real and imaginary parts are Hilbert transforms of each other.

In order to express the dispersion relations over positive values, crossing conditions must be used

$$f(-z) = f^*(z) \quad (21)$$

$$u(-z) + iv(-z) = u(z) - iv(z). \quad (22)$$

Equation (19) can be rewritten as

$$\begin{aligned} u(z_0) &= \frac{1}{\pi} P \int_0^{\infty} \frac{v(z)}{z - z_0} dz + \frac{1}{\pi} P \int_0^{\infty} \frac{v(z)}{z - z_0} dz \\ &= \frac{1}{\pi} P \left[\int_0^{\infty} \frac{v(-z)}{-z - z_0} dz + \int_0^{\infty} \frac{v(z)}{z - z_0} dz \right] \\ &= \frac{1}{\pi} P \left[\int_0^{\infty} v(z) \left\{ \frac{1}{-z - z_0} + \frac{1}{z - z_0} \right\} dz \right] \\ u(z_0) &= \frac{2}{\pi} P \int_0^{\infty} \frac{zv(z)}{z^2 - z_0^2} dz. \quad (23) \end{aligned}$$

Similarly,

$$v(z_0) = -\frac{2}{\pi} P \int_0^{\infty} \frac{z_0 u(z)}{z^2 - z_0^2} dz. \quad (24)$$

The original Kramers-Kronig optical dispersion relations were in the form of equations (23) and (24).

Dispersion relations for the index of refraction can now be written directly except that N does not satisfy the condition given in equation (12). Instead, as $\omega \rightarrow \infty$, the index of refraction, N , approaches unity. In order to satisfy the condition in equation (12), the complex function needs to be defined as

$$f(\omega) = N - 1. \quad (25)$$

The Kramers-Kronig optical dispersion relations now take the form of

$$\Re[N(\omega_0) - 1] = \frac{2}{\pi} P \int_0^{\infty} \frac{\omega}{\omega^2 - \omega_0^2} \Im[N(\omega) - 1] d\omega \quad (26)$$

$$\Im[N(\omega_0) - 1] = -\frac{2}{\pi} P \int_0^{\infty} \frac{\omega_0}{\omega^2 - \omega_0^2} \Re[N(\omega) - 1] d\omega. \quad (27)$$

Thus, the real part of the index of refraction at a particular frequency can be found if the absorption coefficient over the entire frequency range is known.

Evaluating equation (26) requires further manipulation. Rewriting equation (7) in terms of the frequency instead of wavelength,

$$k(\omega) = \frac{\alpha(\omega)}{4\pi\omega} \quad (28)$$

and substituting it into equation (26) results in the rewritten dispersion relation

$$n(\omega_0) = 1 + \frac{1}{2\pi^2} P \int_0^{\infty} \frac{\alpha(\omega)}{\omega^2 - \omega_0^2} d\omega. \quad (29)$$

In order to remove the singularity at $\omega = \omega_0$, the following term is subtracted from equation (29)

$$\frac{1}{2\pi^2} P \int_0^{\infty} \frac{\alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega.$$

This can be done because the term is equal to zero shown by the following,

$$\frac{\alpha(\omega_0)}{2\pi^2} \text{P} \int_0^{\infty} \frac{1}{\omega^2 - \omega_0^2} d\omega = \frac{\alpha(\omega_0)}{2\pi^2} \text{P} \int_0^{\infty} \frac{-1}{\omega_0^2 - \omega^2} d\omega. \quad (30)$$

Using integral tables [27] to evaluate the integral

$$= -\frac{\alpha(\omega_0)}{2\pi^2} \ln \left(\left| \frac{\omega_0 + \omega}{\omega_0 - \omega} \right| \right)_{\omega=0}^{\omega=\infty} = 0. \quad (31)$$

The term is subtracted and equation (29) is now written as

$$n(\omega_0) = 1 + \frac{1}{2\pi^2} \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega. \quad (32)$$

The integrand in equation (32) can be evaluated at the singularity, $\omega = \omega_0$, using

L'Hopital's Rule:

$$\lim_{\omega \rightarrow \omega_0} \frac{\frac{d}{d\omega} [\alpha(\omega) - \alpha(\omega_0)]}{\frac{d}{d\omega} [\omega^2 - \omega_0^2]} = \frac{\alpha'(\omega_0)}{2\omega_0}. \quad (33)$$

In order to evaluate equation (32), the absorption coefficient must be known over the entire spectrum. The integral is broken up into three regions. Region one is from $\omega = 0$ to $\omega = \omega_L$, from zero frequency to the frequency at start of the experimental data. Region two is $\omega = \omega_L$ to $\omega = \omega_U$, the experimental data range. Region three is $\omega = \omega_U$ to $\omega = \infty$, from the frequency at the end of the experimental data range to an infinite wave number. Region one and three are commonly referred to as the wing contributions. The process used for evaluating the wings is to assume that the absorption coefficient is either zero or a constant from the last known experimental data point. These assumptions can be made because of the nature of the denominator. At frequencies far from the frequency at which the calculation is made, the contribution is very small. The determination of $n(\omega_0)$ is most heavily influenced at frequencies closest to ω_0 . Equation (32) is now written as

$$n(\omega_o) = 1 + \frac{1}{2\pi^2} P \left[\int_0^{\omega_L} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_L}^{\omega_U} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_U}^{\infty} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega \right]. \quad (34)$$

The first and third integral are evaluated analytically using integral tables and the second integral is evaluated numerically using the trapezoidal rule or another form of quadrature. A problem arises when evaluating the second integral at $\omega_o = \omega_L$ or ω_U . At these points the integral is undefined since the numerators are constants and the denominator is zero. Therefore, the limits have to be offset by a small δ in order for the frequency to fall outside the range of the experimental data. Equation (34) now becomes

$$n(\omega_o) = 1 + \frac{1}{2\pi^2} P \left[\int_0^{\omega_L - \delta} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_L - \delta}^{\omega_L} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_L}^{\omega_U} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_U}^{\omega_U + \delta} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega + \int_{\omega_U + \delta}^{\infty} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega \right]. \quad (35)$$

For a small δ , the second and fourth integrals can be determined by multiplying the value of the integrand at ω_L and ω_U , respectively by δ .

The first and last integrals in equation (35) are evaluated analytically using the following formulas found in integration tables [27]:

For the assumption $\alpha(\omega) = 0$ outside the experimental data range,

$$\frac{1}{2\pi^2} \int_0^{\omega_L} \frac{-\alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega = \frac{\alpha(\omega_0)}{4\pi^2 \omega_0} \ln \left(\frac{\omega_0 + \omega_L}{\omega_0 - \omega_L} \right) \quad (\omega_0)^2 > (\omega_L)^2 \quad (36)$$

$$\frac{1}{2\pi^2} \int_{\omega_U}^{\infty} \frac{-\alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega = \frac{\alpha(\omega_0)}{4\pi^2 \omega_0} \ln \left(\frac{\omega_U - \omega_0}{\omega_U + \omega_0} \right) \quad (\omega_U)^2 > (\omega_0)^2. \quad (37)$$

For the assumption $\alpha(\omega) = \text{constant}$ outside the experimental data range,

$$\begin{aligned} \frac{1}{2\pi^2} \int_0^{\omega_L} \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega &= \frac{\alpha(\omega) - \alpha(\omega_0)}{2\pi^2} \int_0^{\omega_L} \frac{1}{\omega^2 - \omega_0^2} d\omega \\ &= \frac{\alpha(\omega_0) - \alpha(\omega)}{2\pi^2} \int_0^{\omega_L} \frac{1}{\omega_0^2 - \omega^2} d\omega \\ &= \frac{\alpha(\omega_0) - \alpha(\omega_L)}{4\pi^2 \omega_0} \ln \left(\frac{\omega_0 + \omega_L}{\omega_0 - \omega_L} \right) \quad (\omega_0)^2 > (\omega_L)^2 \end{aligned} \quad (38)$$

$$\frac{1}{2\pi^2} \int_{\omega_U}^{\infty} \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega = \frac{\alpha(\omega_U) - \alpha(\omega_0)}{4\pi^2 \omega_0} \ln \left(\frac{\omega_U - \omega_0}{\omega_U + \omega_0} \right) \quad (\omega_U)^2 > (\omega_0)^2. \quad (39)$$

The third integral term in equation (35) is evaluated numerically using the trapezoidal rule. This integral can be expressed as the summation of the trapezoidal areas

$$\frac{1}{2\pi^2} \int_{\omega_L - \delta}^{\omega_U + \delta} \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega = \frac{1}{2\pi^2} \sum_{j=1}^{nd} \frac{F_{(j+1)} + F_j}{2} (\omega_{(j+1)} - \omega_j) \quad (40)$$

where nd is the number of data points in the experimental data. F_j has singular points at $\omega = \omega_0$. At these points, L'Hopital's Rule is used and the integrand becomes

$$F_j = \frac{\alpha'(\omega)}{2\omega} \quad (41)$$

where $\alpha'(\omega)$ is the derivative of the absorption data at the point $\omega = \omega_0$. The derivative is evaluated using a central difference formula

$$\alpha'(\omega) = \frac{\alpha_{(j+1)} - \alpha_{(j-1)}}{\omega_{(j+1)} - \omega_{(j-1)}}. \quad (42)$$

If $\alpha'(\omega)$ has to be evaluated at the beginning or end of the experimental data, a forward difference or backward difference formula is used respectively.

$$\alpha'(\omega) = \frac{\alpha_{(j+1)} - \alpha_{(j)}}{\omega_{(j+1)} - \omega_{(j)}} \quad \text{forward difference} \quad (43)$$

$$\alpha'(\omega) = \frac{\alpha_{(j)} - \alpha_{(j-1)}}{\omega_{(j)} - \omega_{(j-1)}} \quad \text{backward difference} \quad (44)$$

The real part of the index of refraction can now be calculated. Appendix A contains a computer program to determine the real part of the index of refraction using the equations listed above.

2.4 KRAMERS-KRONIG RELATIONS FOR REFLECTANCE DATA

Reflectance measurements, instead of transmittance measurements, can be used to determine the real and imaginary parts of the index of refraction. This method can be used if the material is highly absorbing over the spectral region of interest. The reflectance, R , of normal incident light is defined by the Fresnel formula as

$$R = r(\omega)r^*(\omega) \quad (45)$$

where $r(\omega)$ is the complex reflection coefficient and is defined as

$$r(\omega) = \frac{(n - ik - 1)}{(n - ik + 1)} \quad (46)$$

and can be written in complex notation by

$$r(\omega) = |r(\omega)|e^{i\theta,(\omega)} \quad (47)$$

where $|r(\omega)|$ is the complex reflectivity amplitude and $\theta_r(\omega)$ is the phase shift. This equation can be rewritten as

$$\ln[r(\omega)] = \ln|r(\omega)| + i\theta_r(\omega). \quad (48)$$

Since the $\ln[r(\omega)]$ is analytic over the contour interval as described earlier and approaches zero as $\omega \rightarrow \infty$, it can now be inserted into the dispersion relations given in equations (23) and (24). The Kramers-Kronig relations for reflectance take the form of

$$\ln|r(\omega_0)| = \frac{2}{\pi} P \int_0^{\infty} \frac{\omega \theta_r(\omega)}{\omega^2 - \omega_0^2} d\omega \quad (49)$$

$$\theta_r(\omega_0) = -\frac{2}{\pi} P \int_0^{\infty} \frac{\omega_0 \ln|r(\omega)|}{\omega^2 - \omega_0^2} d\omega. \quad (50)$$

Applying the same procedure outlined in the above section, the singularity at ω_0 can be removed from equation (50) and the relation takes the form of

$$\theta_r(\omega_0) = \frac{2\omega_0}{\pi} P \int_0^{\infty} \frac{\ln|r(\omega)/r(\omega_0)|}{\omega_0^2 - \omega^2} d\omega. \quad (51)$$

Equation (51) is evaluated in the same manner as outlined in section 2.3. With the phase shift known, the real and imaginary parts of the index of refraction can be calculated from the formulas

$$n(\omega_0) = \frac{1 - r^2(\omega_0)}{1 - 2r(\omega_0) \cos[\theta_r(\omega_0)] + r^2(\omega_0)} \quad (52)$$

$$k(\omega_0) = \frac{-2r(\omega_0) \sin[\theta_r(\omega_0)]}{1 - 2r(\omega_0) \cos[\theta_r(\omega_0)] + r^2(\omega_0)}. \quad (53)$$

Thus the real and imaginary parts of the complex index of refraction can be calculated from experimentally determined reflectance measurements. The reflectance, R , can be determined in a similar manner as the transmittance. From this measurement, $r(\omega)$ can be

calculated and then used in the Kramers-Kronig relation to determine the phase shift, $\theta_r(\omega)$. The equations work for measurements taken at normal or near normal incidence. For oblique angle measurements, some corrections to equation (51) must be made and can be found in the literature [19, 20, 28].

2.5 SUBTRACTIVE KRAMERS-KRONIG RELATIONS

The subtractive Kramers-Kronig method was developed in order to converge upon a solution more quickly and to develop a method that is not as sensitive to the assumptions or extrapolations made for the spectrum outside the experimental data range. The derivation of this method is taken from Ahrenkiel [29] and Tucker [24].

Assume that the real part of the index of refraction and the absorption coefficient is known at some frequency, ω_m , which is within the experimental spectral range. For example, the optical constants may have been determined by independent measurements. The Kramers-Kronig relation from equation (32) expresses this known value of the real part of the index of refraction as

$$n(\omega_m) = 1 + \frac{1}{2\pi^2} \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_m)}{\omega^2 - \omega_m^2} d\omega. \quad (54)$$

Subtracting equation (54) from equation (30) yields

$$n(\omega_o) - n(\omega_m) = \frac{1}{2\pi^2} \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega - \frac{1}{2\pi^2} \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_m)}{\omega^2 - \omega_m^2} d\omega \quad (55)$$

Simplifying,

$$n(\omega_o) = n(\omega_m) + \frac{1}{2\pi^2} \left\{ \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_o)}{\omega^2 - \omega_o^2} d\omega - \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_m)}{\omega^2 - \omega_m^2} d\omega \right\} \quad (56)$$

Thus, the real part of the index of refraction can be determined from experimentally determined absorption data and the optical properties of the substance at a known frequency.

Derived in a similar manner, the subtractive Kramers-Kronig relation to calculate the phase shift from reflectance data is

$$\theta_r(\omega_0) = \theta_r(\omega_m) + \frac{2\omega_0}{\pi} P \int_0^{\infty} \frac{\ln|r(\omega)/r(\omega_0)|}{\omega_0^2 - \omega^2} d\omega - \frac{2\omega_m}{\pi} P \int_0^{\infty} \frac{\ln|r(\omega)/r(\omega_m)|}{\omega_m^2 - \omega^2} d\omega \quad (57)$$

This method will be less sensitive to assumptions made outside the experimental data range because of the subtraction term. However, a reference measurement used inside a large absorption band will produce significant errors since the subtraction term will now contain a numerator.

2.6 DETERMINING OPTICAL CONSTANTS OF SUBSTANCES OTHER THAN WATER USING KRAMERS-KRONIG RELATIONS

Several investigators have used the Kramers-Kronig relations outlined in the previous section to determine optical constants of materials other than water. Khanna et al. [30] determined the extinction coefficient, k , of crystalline C_2H_2 and C_4H_2 using transmittance measurements in the 2-50 μm ($5000\text{-}200\text{ cm}^{-1}$) range. They calculated the real part of the index of refraction using the Kramers-Kronig dispersion relation outlined in Section 2.3. Buffeteau and Desbat [31] developed a general method for determining optical constants of thin films deposited on substrates based upon reflectance and transmittance measurements. They used an iterative Newton-Raphson method to estimate the optical constants based on experimental data and then used Kramers-Kronig relations to improve the accuracy of the real part of the index of refraction.

Ghosal et al. [32] determined the refractive index of CHBr_3 , CCl_4 and CS_2 in the 1-13 μm (10000 – 769 cm^{-1}) range. They used near normal reflectance measurements to calculate the real part of the index of refraction from the Fresnel relations given in equations (42-43). In areas of weak absorption (k very small), Fresnel's equations can provide accurate results. However, in areas of strong absorption, n and k were calculated from Kramers-Kronig relations for reflectance data. In their investigation, they validated their experiment using water and compared their results to Irvine and Pollack [10]. Their calculation of n using the Kramers-Kronig relations did not produce accurate results for water at the end of the experimental spectral region (11-13 μm (909-769 cm^{-1})). This error was caused by the extrapolation of the spectral data outside the experimental data range, which did not account for the increasing extinction coefficient.

Roux and Wood [14] and Wood and Roux [15] used transmittance data and the subtractive Kramers-Kronig relation to determine the optical constants of various thin cryofilms. They used ice to validate their experiment and their results compared favorably with Bertie et al. [11]. Their results for solid ammonia compared favorably with the investigation done by Robertson et al. [13]

Robertson et al. [13] used the subtractive Kramers-Kronig method to determine the real part of the index of refraction for solid ammonia. They outlined two reasons for using this method. First, they could not calculate the real part of the index of refraction directly using Fresnel relations since they did not take any reflectance measurements over the spectrum analyzed. Second, the subtractive method provides a more rapid convergence when data is only available over a limited range. Robertson et al. [13] showed that the calculated values of $n(\omega)$ were relatively unaffected by the assumptions

made about the absorption coefficient outside of the experimental data range. Their results were nearly the same for the assumption that $\alpha(\omega)$ was constant outside the data range or that it gradually decreased to zero.

Palmer et al. [33] developed a multiply subtractive Kramers-Kronig method to determine the optical constants of a material. This improved the subtractive Kramers-Kronig method. The advantage of this method is that it provides accurate results over a small experimental data range. However, multiple independently determined reference points are required. The optimum number of points is dependent upon the size of the experimental data range and the location of these points can affect the accuracy of the determined optical constants. The largest errors occurred when a reference point from a strong absorption band was used.

Tucker [24] employed the subtractive Kramers-Kronig relation to determine n and k for B_2O_3 . Utilizing reflectance and transmittance data from previous researchers, he calculated the index of refraction in the 2-25 μm ($5000\text{-}400\text{ cm}^{-1}$) range. Newquist [25] used the Kramers-Kronig relations to determine n and k from reflectance data. Both used a technique that slightly differed from previous researchers in evaluating the Kramers-Kronig integral numerically. The integral can be evaluated everywhere except at the singular point where $\omega_0 = \omega$, making the integrand undefined. These researchers utilized L'Hopital's Rule to evaluate the integrand at that point (as outlined in section 2.3). This method appears more straightforward than using a quadratic assumption (Downing and Williams [13]) or assuming the integrand is zero at that point (Bertie et al. [11]).

After carefully reviewing the literature, an experiment involving transmittance measurements was designed to directly calculate the absorption coefficient and extinction

coefficient. The real part of the index of refraction is then determined using the Kramers-Kronig relation given in equation (30). This was chosen over reflectance measurements because reflectance measurements do not produce accurate values for the extinction coefficient except in regions of strong absorption. Transmittance measurements could achieve accurate results in strong absorption areas with a small enough cell thickness. The subtractive Kramers-Kronig method could not be used since no independently determined values of n and k near the experimental data range have been determined for the fuels in the investigation (see next section).

2.7 INFRARED SPECTRAL DATA ON HYDROCARBON FUELS

The number of previous studies on the optical constants of hydrocarbon fuels in the infrared is limited [5, 6]. Spectral data from suppliers of spectrophotometric grade chemicals, such as Aldrich, is purely qualitative, intended for chemical composition identification. Published quantitative spectral data is limited. The American Petroleum Institute (API) Report Number 44 [34-57] is a collection of hydrocarbon infrared and ultraviolet spectral data that was generated in the late 1940's and early 1950's. Table 2.1 shows the ranges of the spectral data that was available from API. This is a collection of independent reports submitted by various different research laboratories. Of the nine fuels presented in this thesis, some sort of spectral data was available on each one except for iso-Pentane. The spectral data for the other fuels showed transmittance spectra mostly in the range of 2–15 μm ($5000\text{--}667\text{ cm}^{-1}$). In the ultraviolet range, only data for 1-hexene, toluene and o-xylene was available. These reports qualitatively determined areas of strong absorption, however, no further calculations of the absorption coefficient

or the real and imaginary parts of the index of refraction were ever made. The reports do indicate sample thickness and show the spectral curves measures at various sample thickness.

The absorption bands in the fuels arise from the different types of bond structures between the hydrogen and carbon atoms. At certain energy frequencies, the bonds will stretch, deform/bend, or vibrate. Table 2.2 shows the frequencies at which the paraffin fuels exhibit absorption. Table 2.3 and 2.4 show the absorption bands specific to the olefin and aromatic fuels used in the study, respectively. However, absorption bands for the olefin and aromatic fuels can also occur in regions listed for the paraffin fuels if they contain the noted bond structure. This information was extracted from Bellamy [58] and the API reports [34-57].

The strongest absorption band for the paraffin fuels occurred due to stretching of the carbon-hydrogen bond. Of all the paraffin fuels, only a report for iso-octane was found in the spectral range of 15 – 25 μm (667-400 cm^{-1}). No significant absorption bands are present in this region.

The olefin, 1-hexene, has its strongest absorption due to carbon-hydrogen stretching, though the absorption is not as strong as the paraffin's. An equally strong band occurs at the low-end frequency range due to bond bending. In the ultraviolet region, an absorption band appears past 48,000 cm^{-1} (0.208 μm).

The strongest absorption band for the aromatics is caused by carbon-hydrogen bond bending amongst the free hydrogen atoms around the benzene ring. Because of molecular structure, the aromatic's absorption band near 3000 cm^{-1} was the weakest

Table 2.1 Available fuel spectral data

Carbon Number	Fuel	Formula	Refractive Index ¹	Infrared Spectrum (cm ⁻¹)	Ultra-Violet Spectrum (cm ⁻¹)
Paraffin C _n H _{2n+2}	Iso-Pentane	C ₅ H ₁₂	1.35373		
	Iso-Octane	C ₈ H ₁₈	1.40422	5000-400	
	n-Hexane	C ₆ H ₁₄	1.37486	5000-667	
	n-Heptane	C ₇ H ₁₆	1.38764	5000-667	
	n-Nonane	C ₉ H ₂₀	1.40542	5000-400	
	n-Decane	C ₁₀ H ₂₂	1.41189	5000-667	
	Olefin C _n H _{2n}	1-Hexene	C ₆ H ₁₂	1.38788	5000-400
Aromatic C _n H _{2n-6}	Toluene	C ₇ H ₈	1.49693	5000-667	46000-33000
	o-Xylene	C ₈ H ₁₀	1.50545	5000-667	58000-33000

¹Refractive index at 20 °C and are for the sodium D line, wavelength 5892.6 Angstrom units (16970 cm⁻¹)

amongst all of the fuels at this frequency. In the ultraviolet region, a strong absorption band is present at 38,000 cm⁻¹ (0.263 μm) for both aromatics.

Pure saturated hydrocarbons, e.g., the paraffin fuels, do not absorb in the ultraviolet region and are therefore sometimes used as solvents to mix with absorbing species to measure their spectra. This was the case in the API reports for the olefin and aromatic fuels, which were diluted in iso-octane. The double bonds found between carbon atoms in the olefin and aromatic fuels are responsible for the absorption in the ultraviolet region. Information about hydrocarbon ultraviolet absorption was taken from Clark et al. [59].

Table 2.2 Paraffin Absorption Band Locations

Type	Molecular Group	Frequency (cm ⁻¹)
CH Stretching	CH ₃	2962 and 2872 ± 10
	CH ₂	2926 and 2853 ± 10
CH Deformation	C-CH ₃	1450 ± 20
	-CH ₂ -	1465 ± 20
	C-CH ₃	1380-1370
	-C-(CH ₃) ₂	1385-1380 and 1370-1365
	-C-(CH ₃) ₃	1395-1385 and 1365
CH Skeletal Vibrations	(CH ₃) ₂ -C-	1170-1140
	-(CH ₂) ₄ -	750-720

Table 2.3 Olefin Specific Absorption Bands

Type	Molecular Group	Frequency (cm ⁻¹)
C=C Stretching	C=C	1680-1620
CH Stretching	-CH=CH-	3040-3010
	CH=CH ₂	3040-3010 and 3095-3075
CH Deformation	-CH=CH-	970-960
	CH=CH ₂	995-985, 915-890, 1856-1800 and 1420-1410
UV Absorption	C=C	48,000

Table 2.4 Aromatic Specific Absorption Bands

Type	Molecular Group	Frequency (cm ⁻¹)
CH Stretching	=C-H	3030-3010
CH Deformation	5 adjacent free H	770-730 and 710-690
	4 adjacent free H	770-735
Skeletal Ring Vibrations	benzene ring	1400-1600
UV Absorption	C=C	38,000

3. EXPERIMENTAL SET-UP

Figure 3.1 illustrates the experimental set-up. The experiment was designed with several factors involved. Factors such as, spectral range, resolution, ease of alignment, and repeatability were balanced by overall cost. Spectroscopy systems still remain quite expensive and thus a simple grating instrument experiment was designed to provide spectral data in the approximate range of 2.5-15.0 μm (4000-667 cm^{-1}).

An Oriel infrared monochromator illuminator provided a broad spectral bandwidth infrared beam. A mirror inside the illuminator housing focused the beam to match the acceptance cone of the monochromator. An Oriel 1/8 m Ebert-Fastie design monochromator grated the infrared beam. Three gratings were used to cover the spectral region in the experiment. Before entering the monochromator, the beam passed through a filter wheel with short wavelength cut-off filters to block higher order wavelengths from passing through to the detector. The beam was collimated leaving the monochromator by a lens made from Amorphous Material Transmitting Infrared Radiation (AMTIR). The sample cell was a Fourier Transform InfraRed (FTIR) demountable transmittance cell from Pike Technologies. The windows in the cell were made of zinc selenide (ZnSe). Multiple thicknesses were achieved by interchanging an assortment of teflon spacers that ranged from 0.015 mm to 1.0 mm. The fuels were entered into the sample cell via a syringe. The fuels were all spectrophotometric grade from the Aldrich Chemical Company. After the data was collected, the cell was evacuated with a vacuum pump.

A ZnSe lens collected the radiation passing through the sample cell and focused it onto the active area of the infrared detector. The detector used was an Electro-Optical

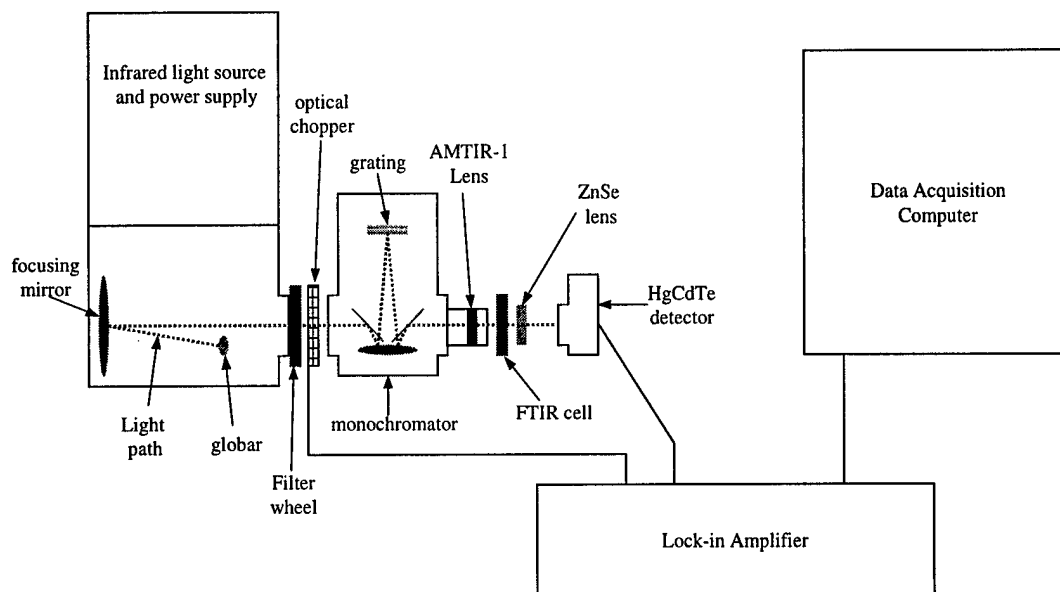


Figure 3.1 Schematic of experimental set-up

Systems Mercury-Cadmium-Telluride (HgCdTe) cryogenically operated photo-detector. The detector was cooled to 77 K with liquid nitrogen and had an active area of one square millimeter. A signal pre-amplifier was integrated into the photo-detector housing. The detector fed the signal into an EG&G Judson lock-in amplifier. A 100 Hz optical chopper, placed at the opening of the filter wheel attached to the infrared illuminator housing, provided the reference signal for the lock-in amplifier. Data was collected via a computer data acquisition system connected to the lock-in amplifier. The signal-sampling rate was 10 samples per second. The signal was time averaged over a three-second period for each wavelength. The entire set-up was mounted on an optics table.

The resolution and bandwidth of the monochromator was dependent upon the particular grating in the monochromator. In order to maximize signal intensity, the entrance and exit openings of the monochromator were set at their maximum, 3.0 mm. From the 2.5-5 μm (4000-2000 cm^{-1}) range, data points were collected every eight

nanometers (nm) with a bandwidth of ± 78 nm. In the 5-9 μm (2000-1111 cm^{-1}) range, data was taken at 16 nm intervals with a bandwidth of ± 158 nm. In the 9-15 μm (1111-667 cm^{-1}) range, data was taken at 24 nm intervals with a bandwidth of ± 236 nm. The wavelength size of the sampling interval was small enough to achieve a frequency interval of ≤ 10 cm^{-1} throughout the experimental data range.

Because of the narrow absorption bands found in hydrocarbon fuels, the bandwidth was reduced. For the range of 2.5-5.4 μm (4000-1852 cm^{-1}), the entrance and exit openings were reduced to one millimeter. This produced a bandwidth of ± 26 nm. In order to maintain the same bandwidth from 5.4-10.4 μm (1852-962 cm^{-1}) with the second grating, the size of the openings was further reduced to 0.5 mm. In order to use the third grating, which has a higher reflectance past 10.4 μm (962 cm^{-1}) than the second grating, the monochromator openings would have to be even further reduced. This produced an unacceptable signal to noise ratio. In order to maintain an acceptable signal to noise ratio from 10.4-14 μm (962-714 cm^{-1}), the second grating was used and the size of the openings were increased to one millimeter, resulting in a bandwidth of ± 52 nm. The sampling interval was every eight nanometers from 2.5-5.4 μm (4000-1852 cm^{-1}) and every 16 nm from 5.4-14.4 μm (1852-714 cm^{-1}).

The reduction of bandwidth significantly reduces the intensity of the infrared beam. The energy reaching the detector is proportional to the square of the width of either the entrance or exit opening [60]. The exit and entrance slits were kept at equal widths and were adjusted in order to achieve the smallest bandwidth (resolution) possible and still maintain an acceptable signal to noise ratio. The experimental range was reduced from 15 μm to 14 μm (667 cm^{-1} to 714 cm^{-1}) because the intensity of the

radiation could not produce an acceptable signal to noise ratio to counter the affect of the CO₂ absorption band located at 14.98 μm (668 cm^{-1}) [60].

Spectral data was collected first on the empty cell. The measured intensity was the value above the average background noise that was measured before and after the scan. Background noise was measured by blocking the exit aperture from the filter wheel. The cell was then removed from the holder, filled, and replaced into the holder. The scan was then completed and background noise measured as indicated previously. After scanning the filled cell, it was emptied, taken apart, cleaned, and reassembled with a different thickness spacer.

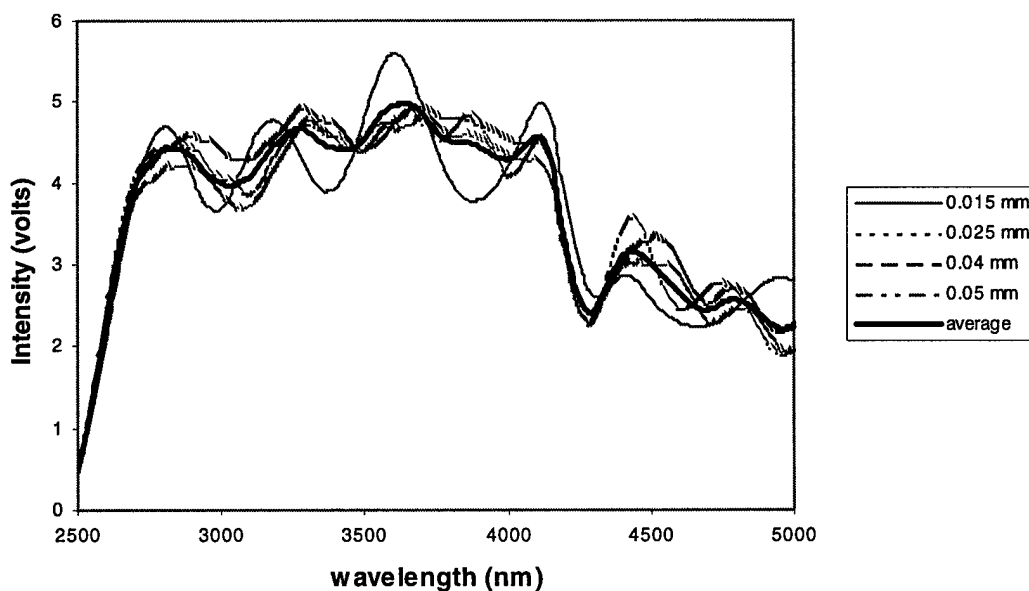


Figure 3.2 Interference pattern observed in intensity measurements on empty cells of small thickness

A constructive and destructive interference pattern was present in empty cell measurements of cell thickness less than 0.05 mm. Figure 3.2 shows the typical interference pattern seen from empty cell measurements. In cell thickness above 0.05 mm, the interference pattern is greatly reduced and the fluctuations in radiation intensity are due to reflectance efficiencies and Wood's anomalies of the monochromator gratings, atmospheric absorption bands (CO_2 at $4.25 \mu\text{m}$ (2353 cm^{-1})) [60], and transmittance properties of the lenses and filters. Figure 3.3 shows the intensity from several empty thick cell measurements. The interference pattern is caused by the large difference between the index of refraction of air and the index of refraction of the ZnSe windows.

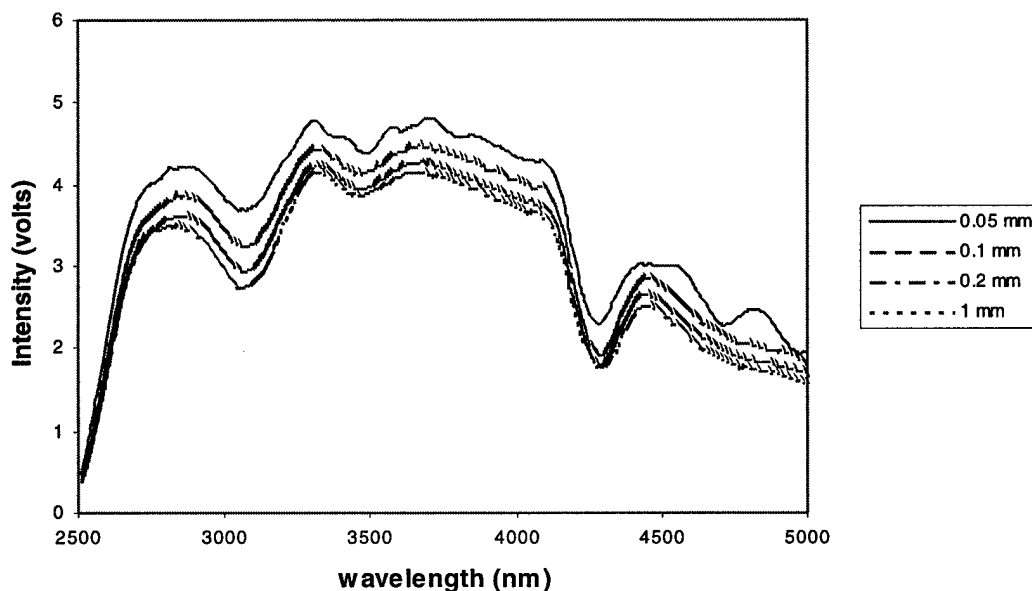


Figure 3.3 Intensity measurements of empty thick cells

When the empty cell is filled, the difference between the refractive index is reduced and the interference pattern is removed. ZnSe windows were chosen over other materials because of its durability. Other infrared lenses are typically made from salts, are water soluble, and require special operating environments.

In order to reduce the effect of the interference pattern on small thickness measurements, an average empty cell value was determined. This value was calculated by averaging the intensity measurements from cells of 0.015, 0.025, 0.040, and 0.050 mm thickness. Empty and filled cell measurements were made for every cell thickness over 0.05 mm.

The absorption coefficient was determined directly from transmittance measurements as explained in the previous section. Cell thickness was selected in order to produce a desired transmittance between 30 and 70%. The absorption coefficient was chosen from transmittance data in this range. If transmittance measurements could not produce a value above 30%, the highest transmittance value was used. In areas of very strong absorption where the smallest spacer was in place, transmittance measurements of less than one percent were used. If two transmittance values were both between 30 and 70%, the one that produced the smoothest absorption curve was selected. Appendix B contains the step by step operating procedure used for collecting data.

4. EXPERIMENTAL VALIDATION

4.1 USING THE KRAMERS-KRONIG RELATIONS WITH PUBLISHED WATER DATA

The first step to the experimental validation was to develop a computer code to calculate the real part of the index of refraction using the Kramers-Kronig optical dispersion relations. The program was written in QuickBasic and based on programs developed by Tucker [24] and Newquist [25]. As indicated previously, in order to use the Kramers-Kronig relations, the entire spectrum must be known. Outside the experimental range, the spectrum must be extrapolated.

4.1.1 Additive Correction to Kramers-Kronig Dispersion Relations. The index of refraction calculated from published absorption data using equation (32) along with established data values from Downing & Williams [12] is shown in Figure 4.1. Clearly, even with accurate assumptions of the spectrum outside the experimental range, an additional term is needed to produce accurate results.

Robertson, et al. [61] took into consideration the effect of an estimated, hypothetical, and very strong narrow ultraviolet (UV) absorption band for water centered at $40,000 \text{ cm}^{-1}$ ($0.250 \text{ }\mu\text{m}$). The contribution was added to equation (32) and is expressed as

$$\Delta_{UV}n(\omega_o) = \frac{1}{2\pi^2} P \int_0^{\infty} \frac{\alpha_{UV}(\omega)}{\omega^2 - \omega_o^2} d\omega. \quad (58)$$

For an ultraviolet absorption band centered at some high frequency, ω_H , and limited between ω_a and ω_b , the integration limits on equation (58) can be changed to ω_a and ω_b . For the conditions of the infrared frequency, $\omega_o \ll \omega_H$ and $(\omega_b - \omega_a) \ll \omega_H$, equation (58) can be written as the following second order approximation

$$\Delta_{UV}n(\omega_0) = \frac{\frac{1}{2\pi^2} \text{P} \int_{\omega_a}^{\omega_b} \frac{\alpha_{UV}(\omega)}{\omega^2} d\omega}{1 - (\omega_0 - \omega_H)^2} = \frac{\text{constan t}}{1 - (\omega_0 - \omega_H)^2}. \quad (59)$$

Equation (32) now becomes

$$n(\omega_0) = 1 + \Delta_{UV}n(\omega_0) + \frac{1}{2\pi^2} \text{P} \int_0^{\infty} \frac{\alpha(\omega) - \alpha(\omega_0)}{\omega^2 - \omega_0^2} d\omega. \quad (60)$$

The additive constant in equation (59) was chosen to give a value for n of 1.303 at a frequency of 5000 cm^{-1} ($2 \mu\text{m}$). This is based on the accepted value given by Downing and Williams [12]. This additive term is essentially an offset constant to the calculated values. Recall that in order to use this dispersion relation, the complex function must

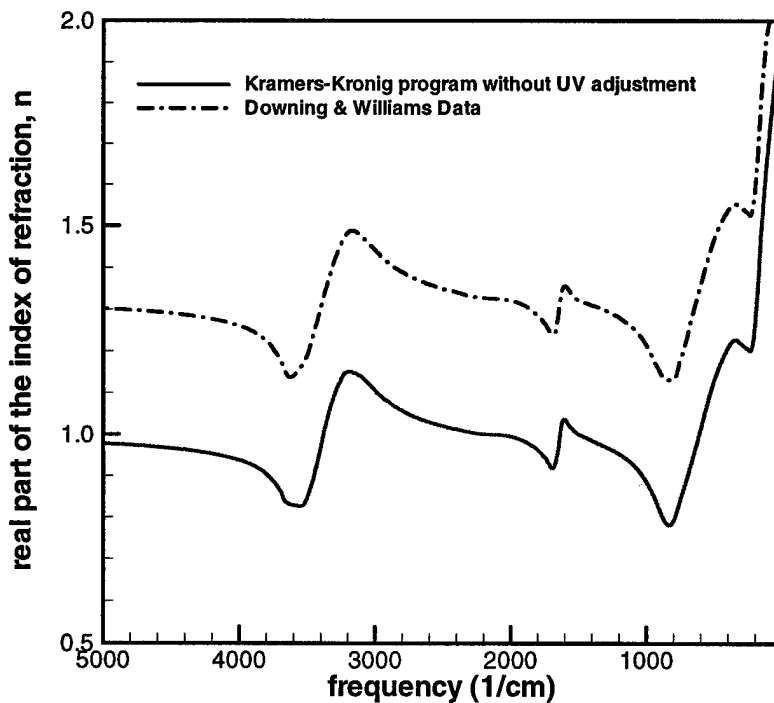


Figure 4.1 Kramers-Kronig program results for water without an adjustment factor. Published absorption data was used to determine n .

vanish as the frequency approaches an infinite wave number. At this infinite wave number, the complex index of refraction is theoretically unity. Some contribution at wavelengths far from the measured results is used to adjust the real part of the index of refraction from the determined value in the visible spectrum to unity at an infinite frequency. Like Robertson et al. [61], Downing and Williams [12] took this into account by assuming the contribution from a single far ultraviolet band that would yield the proper value of the real part of the index of refraction at a frequency which is accurately known. In their case, they used a value for n at 5000 cm^{-1} ($2 \mu\text{m}$). Unfortunately, they did not publish the method used to add this contribution to equation (32) or the frequency at which they assumed the location of this band. Zolotarev et al. [62] used a model band located at $100,000 \text{ cm}^{-1}$ ($0.100 \mu\text{m}$). The hypothetical absorption band is simply an offset adjustment that must be used in order to match existing data for frequencies. The location of the hypothetical absorption band can have a significant impact on the determination of n outside the experimental data range.

The index of refraction for hydrocarbon fuels at 16960 cm^{-1} ($0.590 \mu\text{m}$) has been determined [57]. In order to use this value in the Kramers-Kronig method, calculations of the real part of the index of refraction of water were made to investigate the effect of the location of the hypothetical UV band. Figure 4.2 shows the calculated real part of the index of refraction by choosing a known reference value at 5000 cm^{-1} ($2 \mu\text{m}$). The location of the ultraviolet band was placed at $40,000 \text{ cm}^{-1}$ ($0.250 \mu\text{m}$) and then at the higher frequency of $100,000 \text{ cm}^{-1}$ ($0.100 \mu\text{m}$). The effect on n in the experimental data range was negligible. This was not the case for calculations done with the reference value at $16,960 \text{ cm}^{-1}$ ($0.590 \mu\text{m}$). The UV band at $40,000 \text{ cm}^{-1}$ ($0.250 \mu\text{m}$) produced

values that were in far less agreement than values calculated with the UV band located at $100,000 \text{ cm}^{-1}$ ($0.100 \mu\text{m}$), as shown in Figure 4.3. The calculated value for n using the UV band at $100,000 \text{ cm}^{-1}$ ($0.100 \mu\text{m}$) produced nearly same results for both reference points. In light of these results, the values for the index of refraction for the hydrocarbon fuels at 16960 cm^{-1} ($0.590 \mu\text{m}$) and an UV band at $100,000 \text{ cm}^{-1}$ ($0.100 \mu\text{m}$) were used for the determination of the real part of the index of refraction in the infrared.

Figure 4.4 shows the calculated value of n using the computer program with the correction factor used by Robertson et al. [61]. As for Figure 4.1 and 4.2, the computer program used absorption data from Downing and Williams [12] in the frequency range of $5000\text{-}10 \text{ cm}^{-1}$ ($2\text{-}1000 \mu\text{m}$). Outside this range, the assumptions employed by Robertson

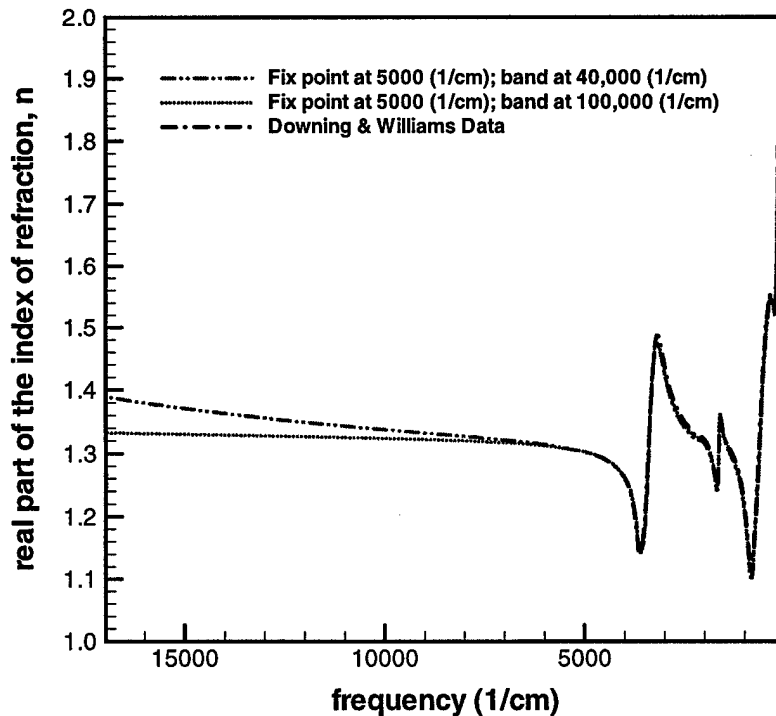


Figure 4.2 Calculated real part of the index of refraction of water using a fixed point at 5000 cm^{-1} and hypothetical UV bands at $40,000$ and $100,000 \text{ cm}^{-1}$

et al. [61] were used. These assumptions included using data from Palmer and Williams [18] in the $8400\text{-}5000\text{ cm}^{-1}$ ($1.19\text{-}2\text{ }\mu\text{m}$) range and then letting $\alpha(\omega)$ decrease linearly to a value of $1.5 \times 10^{-4}\text{ cm}^{-1}$ at 16960 cm^{-1} ($0.590\text{ }\mu\text{m}$), an independently determined value. At higher frequencies, $\alpha(\omega)$ went to zero. Below 10 cm^{-1} ($1000\text{ }\mu\text{m}$), $\alpha(\omega)$ also went to zero. As seen in Figure 4.3, the computer program produced values of n that are in excellent agreement with accepted values which have been determined both computationally and experimentally [12].

4.1.2 Effect of Wing Extrapolation. Next, the effect of data extrapolation outside the experimental data range was investigated. According to Bertie et al., [11], the assumptions used to extrapolate data outside the experimental range had little effect on

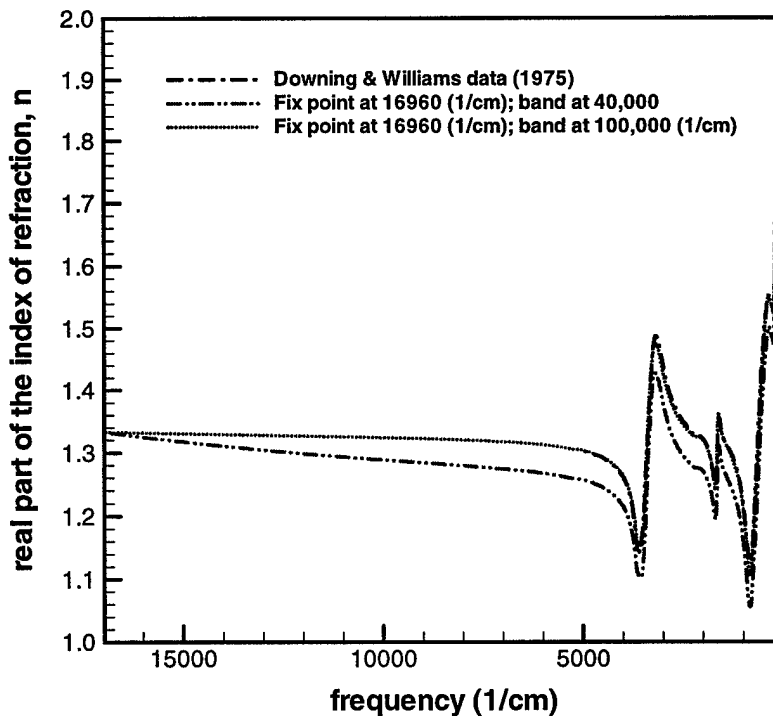


Figure 4.3 Calculated real part of the index of refraction of water using a fixed point at 16960 cm^{-1} and hypothetical UV bands at $40,000$ and $100,000\text{ cm}^{-1}$

the calculation of n using the Kramers-Kronig relations. This may be true for ice, but was not the case for water, as demonstrated by Ghosal et al. [32]. Using Downing and Willaims [12] data in the $5000 - 667 \text{ cm}^{-1}$ ($2-15 \mu\text{m}$) range as the experimental data, n was calculated based on the assumption that $\alpha(\omega)$ was zero outside the experimental range. Further, a calculation was performed assuming $\alpha(\omega)$ was constant from the endpoint of the experimental values. Figure 4.5 shows the calculated n using both of these assumptions compared with accepted values. The disagreement with the accepted values of n stem from the fact that at 667 cm^{-1} ($15 \mu\text{m}$), the value of $\alpha(\omega)$ is approximately 3000 cm^{-1} . This value decreases eventually to zero as the frequency goes to zero. Both assumptions, that $\alpha(\omega)$ is zero or that it remains constant, on the low

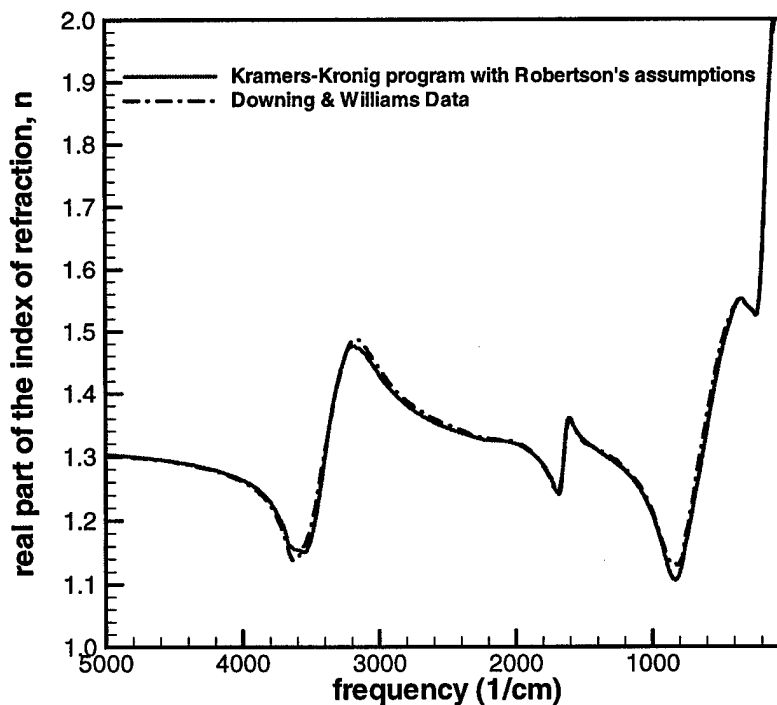


Figure 4.4 Kramers-Kronig program results for water using assumptions by Robertson et al. [61] to extrapolate outside the data range

frequency side of the data range are not very accurate. A more accurate assumption is one that involves the imaginary part, k , of the index of refraction. Recall equation (28) for the extinction coefficient,

$$k(\omega) = \frac{\alpha(\omega)}{4\pi\omega}$$

Since k is a function of the frequency and the absorption coefficient, an assumption of its behavior outside the data range will probably produce a better assumption about $\alpha(\omega)$. A relatively large value for α can occur at high frequencies when the extinction coefficient, k , is small. The absorption coefficient is used in the relation since it is determined directly from experimental results.

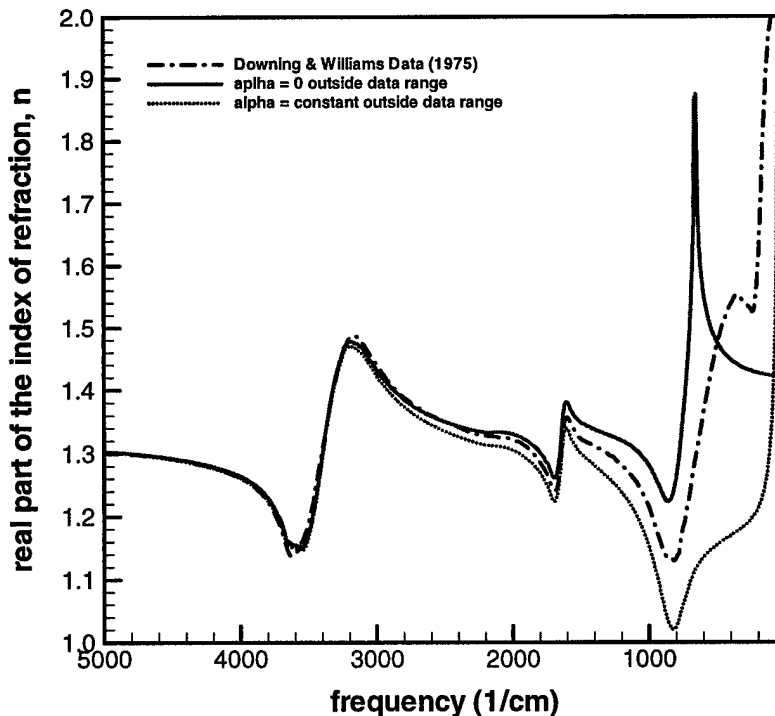


Figure 4.5 Kramers-Kronig program results for water using assumptions for the absorption coefficient to extrapolate outside the data range

Figure 4.6 shows the calculated n using two different assumptions about k . The first was that k was constant from the endpoints of the experimental values. Second, k was constant from the low frequency range to zero frequency and linearly went to zero from the high frequency end point to 16960 cm^{-1} ($0.590 \mu\text{m}$). These assumptions more accurately model the behavior of k and $\alpha(\omega)$ outside the experimental data range and both produced almost identical results for the value of n . The results are much better in agreement than the results using the assumptions for $\alpha(\omega)$. Additionally, for the calculations in both Figures 4.4 and 4.5, data points from the range of $16960\text{-}10 \text{ cm}^{-1}$ ($0.590\text{-}1000 \mu\text{m}$) were included from the experimental data points. These points were then used in the numerical integration part of the evaluation of the Kramers-Kronig

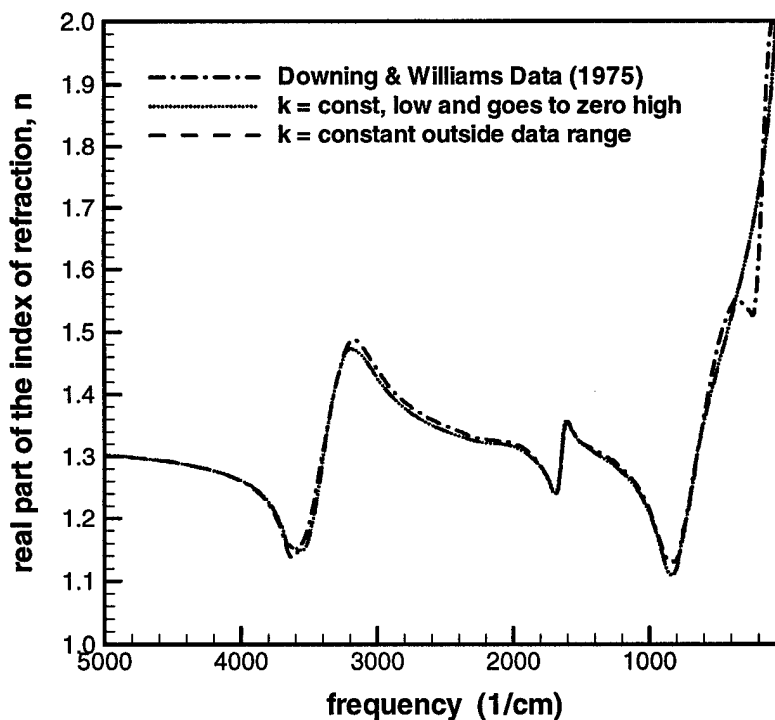


Figure 4.6 Kramers-Kronig program results for water using assumptions for the imaginary part of the index of refraction to extrapolate outside the data range

relation. This produced better results than by using just data points in the experimental data range in the numerical integration because the wing contributions are minimized.

Therefore, modeling the absorption coefficient upon the actual behavior of the extinction coefficient will produce better results for the real part of the index of refraction. Another reason for assumptions about k producing better results is simply the fact that the original dispersion relation calculates the real part of the index of refraction from the extinction coefficient. Extrapolating data using assumptions strictly about the absorption coefficient will produce significant error if the absorption coefficient is not modeled properly, especially if the assumptions do not take into consideration the effect of large, strong absorption bands.

4.1.3 Wing Extrapolations with Subtractive Kramers-Kronig Method.

Figure 4.7 shows the calculated value of n using the subtractive Kramer-Kronig method. The reference value for n was taken at 5000 cm^{-1} ($2 \mu\text{m}$). Two assumptions for the extrapolated data range were used. One used the assumptions that Robertson et al. [60] used for the absorption coefficient, the other was that the imaginary part of the index of refraction was constant at the low end of the experimental data range and went to zero at the high end of the range. Both assumptions provided similar results. This method can be very sensitive to the chosen reference value as reported by Palmer et al. [33]. Using a reference value from either the center of the strong absorption band at 3390 cm^{-1} ($2.95 \mu\text{m}$) or far away from the experimental data range (16960 cm^{-1} ($0.590 \mu\text{m}$)) produced erratic results. The reference value must be close to or within the experimental range. The method did converge on a solution more quickly than the original Kramers-Kronig relations and also did not require an adjustment factor in order to converge upon a

solution. However, the subtractive method does require independently determined optical constant data near the experimental data range for a reference point.

4.2 EXPERIMENTAL RESULTS FOR WATER

Figure 4.8 shows the experimentally determined absorption coefficient for water as compared to the published data. Measurements were made with the two smallest available cell widths, 0.015 and 0.025 mm. Water is highly absorbing in the infrared. Although the absorption coefficient of the band centered at 3390 cm^{-1} ($2.95\text{ }\mu\text{m}$) is over 50% less than the accepted value, there is still good agreement between the experimental data and the published values. A much smaller cell thickness must be used in order to

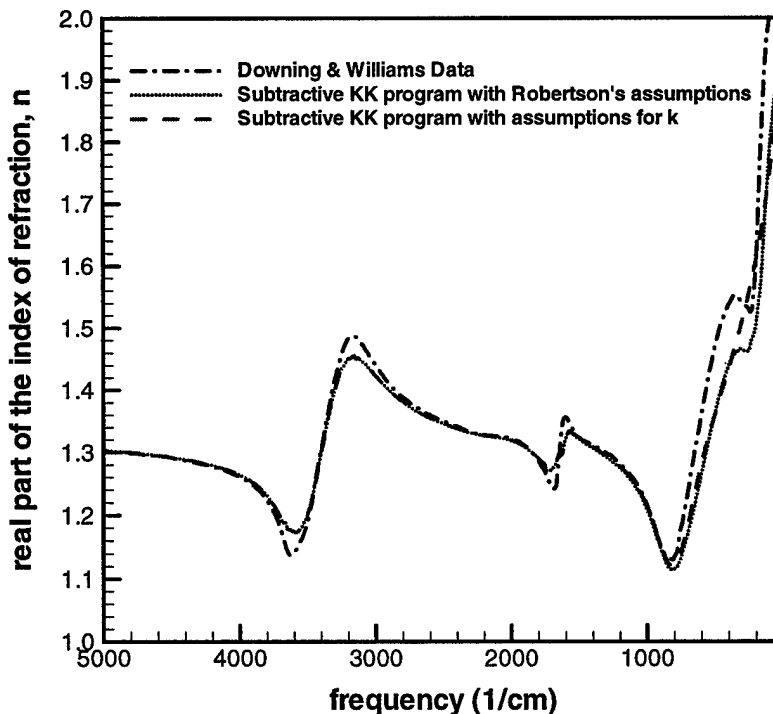


Figure 4.7 Subtractive Kramers-Kronig program results for water using $n = 1.303$ at 5000 cm^{-1} as the reference value

measure absorption coefficients that are the order of 10^4 . The absorption band centered at 1640 cm^{-1} ($6.10\text{ }\mu\text{m}$) is narrower than the band at 3390 cm^{-1} ($2.95\text{ }\mu\text{m}$). The bandwidth used was too large to accurately measure this absorption. The discrepancy at this frequency is due to the size of the spectral slit width of the monochromator. The spectral slit width is the small spectral region that is isolated by the exit and entrance slit of the monochromator. If the width of the absorption band is smaller than the spectral slit width, the detector will measure intensity that is outside the absorption band. This will cause the measurement of a transmittance value that is higher than it actually is, thus causing an under-calculated value for the absorption coefficient. Interference effects caused the wavy pattern seen in the weaker absorbing ranges. Using larger cell widths to

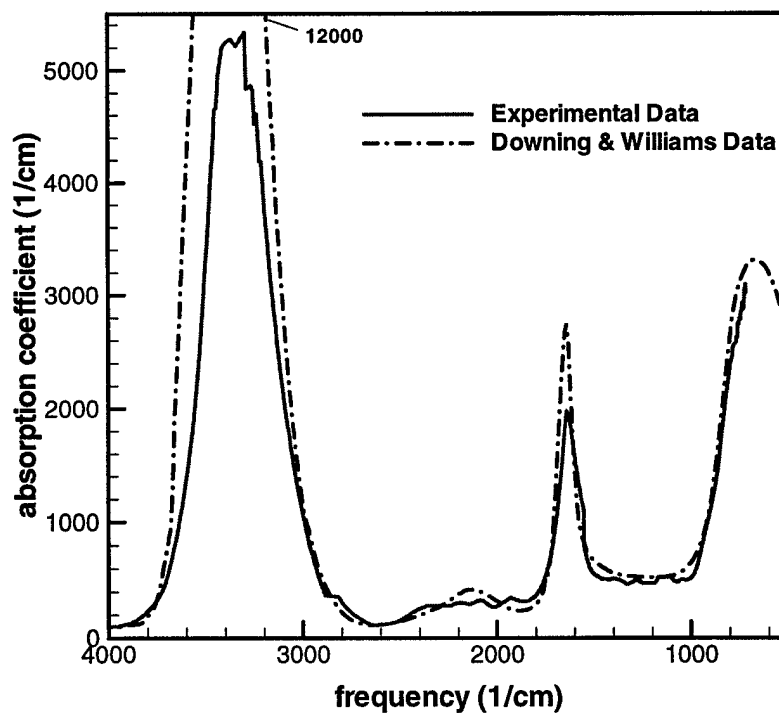


Figure 4.8 Experimentally determined absorption coefficient for water

minimize this effect could not be done because of how strongly water absorbs across the infrared spectrum.

Figure 4.9 shows the calculated index of refraction for water using the experimental data. Outside the experimental data range, the assumptions by Robertson et al. [61] were used as described in the previous section. The lower calculated absorption coefficient at 3390 cm^{-1} ($2.95\text{ }\mu\text{m}$) caused the reduced fluctuation in the index of refraction. However, despite this difference in calculated absorption coefficients, the effect on the calculation of the real part of the index of refraction is much smaller. The experimental values differ with accepted values by less than 10% at the largest discrepancy.

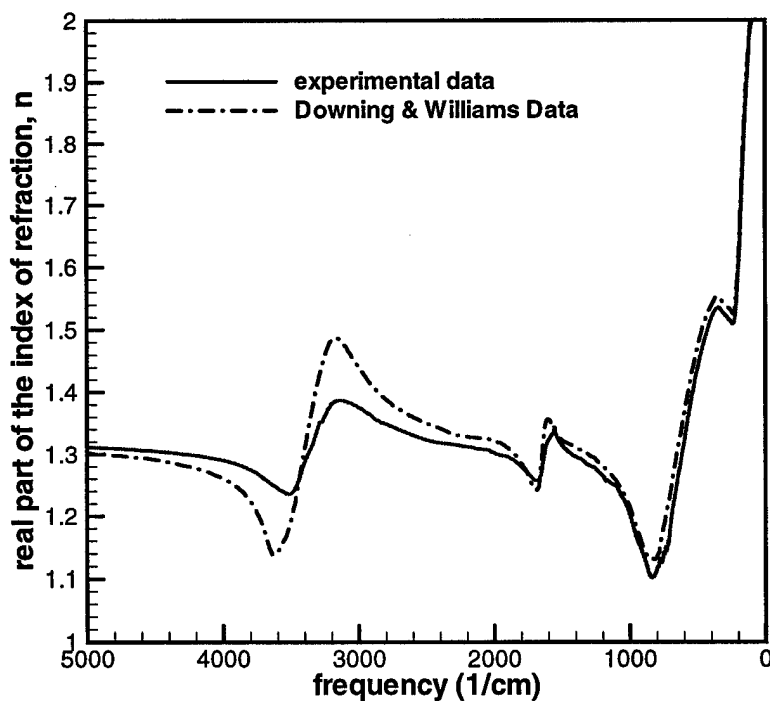


Figure 4.9 Experimentally determined real part of the index of refraction for water

The results for water prove that the designed experiment will provide acceptable results for liquids that are slightly less absorbing. For the liquid hydrocarbon fuels, the bandwidth could be decreased to provide greater resolution, and since the fuels are not nearly as absorbing as water, utilizing thicker cell widths can minimize the interference effects.

5. RESULTS AND DISCUSSION

The results of the investigation are presented in three sections, paraffin, olefin, and aromatic. For each fuel, figures showing the transmittance curves, absorption coefficient, extinction coefficient, k , and the real part of the index of refraction, n are given. The experimental data is presented in tabular form in Appendix C. The absorption coefficient was determined directly from the transmittance data using the guidelines outlined in the experimental protocol given in section three. The reduction of the bandwidth significantly reduced the radiant intensity, and thus, the signal to noise ratio decreased. This caused some difficulties in acquiring reliable data in the longer wavelength (weaker energy) region of the experimental data range. The best signal to noise ratio that was present was from 2.5-5.4 μm . (4000-1852 cm^{-1}). The signal to noise ratio worsened as the wavelength increased. API data was used as a guide to help determine the difference between noise and absorption due to molecular structure. API data was also used as a guide to determine which cell thickness to use at which location in the experimental data range.

The method used for extrapolating data outside the experimental range for use in the Kramers-Kronig analysis was the same for all of the fuels. Any available data from API reports was used to expand the experimental data range. For all the fuels, except isopentane, this expanded the data range to 2-15 μm (5000-667 μm) and in some cases, the range expanded to 25 μm (400 cm^{-1})(see Table 2.1 for available API data ranges). The value of the absorption coefficient was then held constant from the last value at the edge of the expanded data range to 16960 cm^{-1} (0.590 μm) on the high frequency side and to 10 cm^{-1} (1000 μm) on the low frequency side. The absorption coefficient then went to

zero outside these frequencies. This assumption was used for the data extrapolation, instead of modeling the absorption coefficient on the extinction coefficient, because it was the easiest and best method to fit the behavior of the transmittance data available. Using assumptions about the extinction coefficient had a negligible effect on the calculations of the real part of the index of refraction as compared to using the assumption about the transmittance curve. This is because the assumptions are modeling areas of the spectrum that have very little absorption. Outside of the infrared region, the hydrocarbon fuels exhibit little absorption, except for narrow bands in the ultraviolet region in the cases of the olefin and aromatics. The effect of any ultraviolet absorption is taken into consideration with the adjustment factor as explained Section 2. For every fuel, the absorption coefficient was assigned a value of less than 10 cm^{-1} outside the data range, indicated little to no absorption.

Table 5.1 shows the results for all of the fuels at $3.39 \mu\text{m}$ (2950 cm^{-1}). For the paraffin fuels, this location is just at the edge of their strongest absorption band. Because the absorption coefficient is changing very rapidly, measured transmittance is significantly influenced by the spectral slit width.

5.1 PARAFFIN

The experimental results for the paraffin fuels are presented in two sub-sections. The normal, or straight chain, paraffin fuels are separated from iso-octane and iso-pentane.

5.1.1 Iso-Octane and Iso-Pentane. Figure 5.1 and 5.2 show the transmittance curves for iso-octane and iso-pentane. Figures 5.3 and 5.4 show the absorption curve,

Table 5.1 Experimental results at 3.39 μm

Fuel	absorption coefficient, α (cm^{-1})	extinction coefficient, k	refractive index, n
iso-octane	2573	0.0695	1.336
iso-pentane	1655	0.0447	1.310
n-hexane	1352	0.0365	1.318
n-heptane	1264	0.0341	1.338
n-nonane	1184	0.0320	1.355
n-decane	1108	0.0229	1.362
1-hexene	1187	0.0320	1.357
o-xylene	472	0.0127	1.487
toluene	211	0.0057	1.484

Figures 5.5 and 5.6 show the imaginary part of the index of refraction and Figures 5.7 and 5.8 show the real part of the index of refraction for iso-octane and iso-pentane respectively. Transmittance measurements were difficult to obtain for iso-pentane because of its high vapor pressure. Since the sample cell did not perfectly seal (a disadvantage to demountable cells), the fuel would quickly evaporate. Data was acquired in four-minute intervals. During the scan, the cell was continually monitored to ensure that the fuel had not evaporated down to a level that crossed the incident beam. If the level did, or after four minutes, the cell was evacuated, refilled, and placed back into position.

Table 5.2 presents a comparison of the results at 3.39 μm (2950 cm^{-1}) for iso-octane with the results from the API and the study done by Drallmeier and Peters [5]. The iso-octane data from the API was digitized and is presented for comparison with the

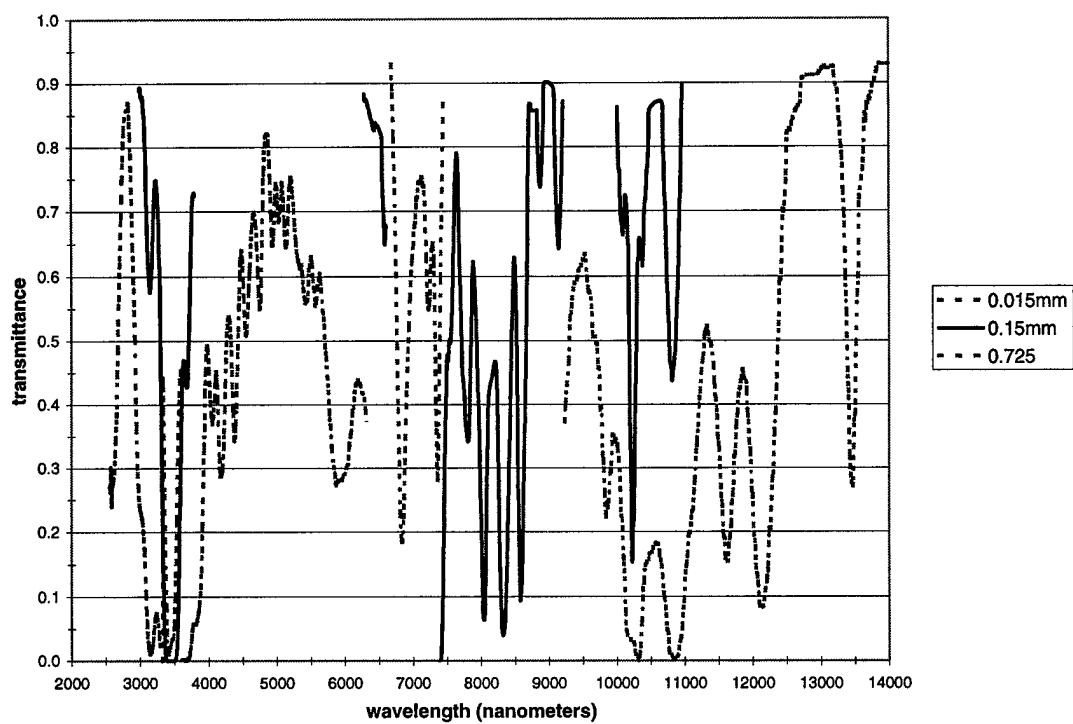


Figure 5.1 Transmittance of iso-octane

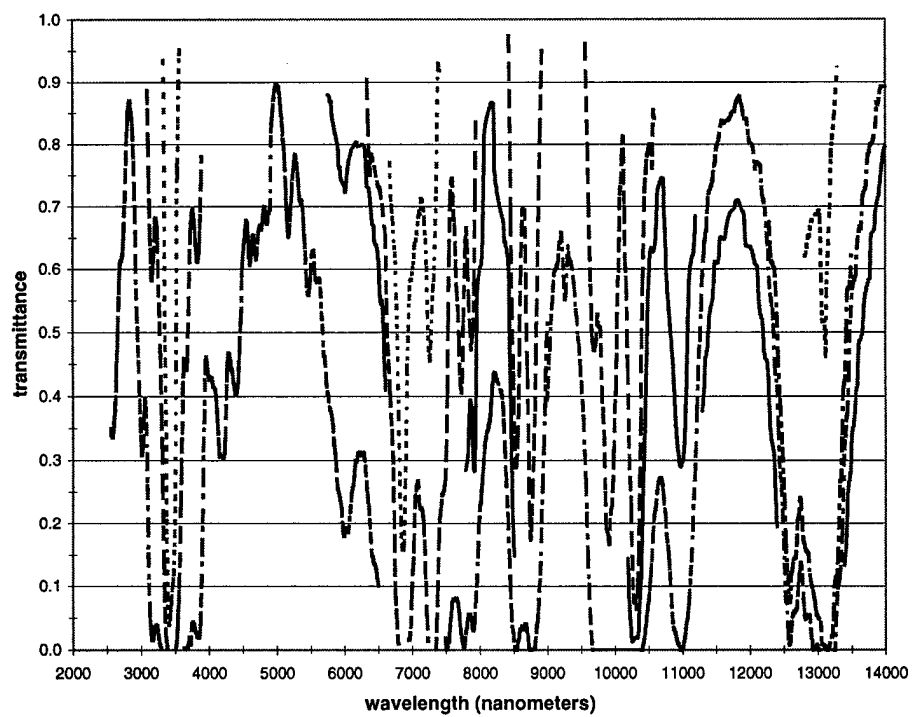


Figure 5.2 Transmittance of iso-pentane

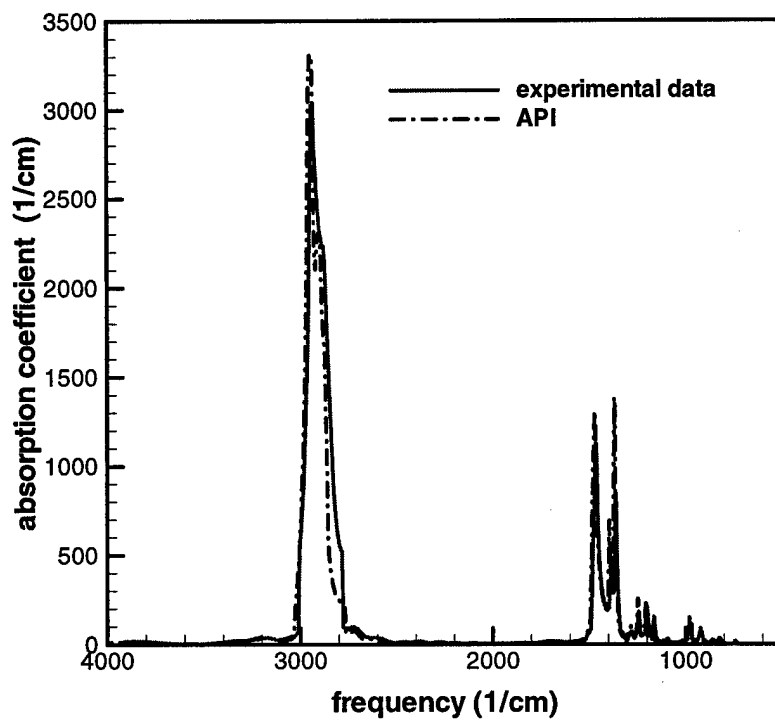


Figure 5.3 Absorption coefficient for iso-octane

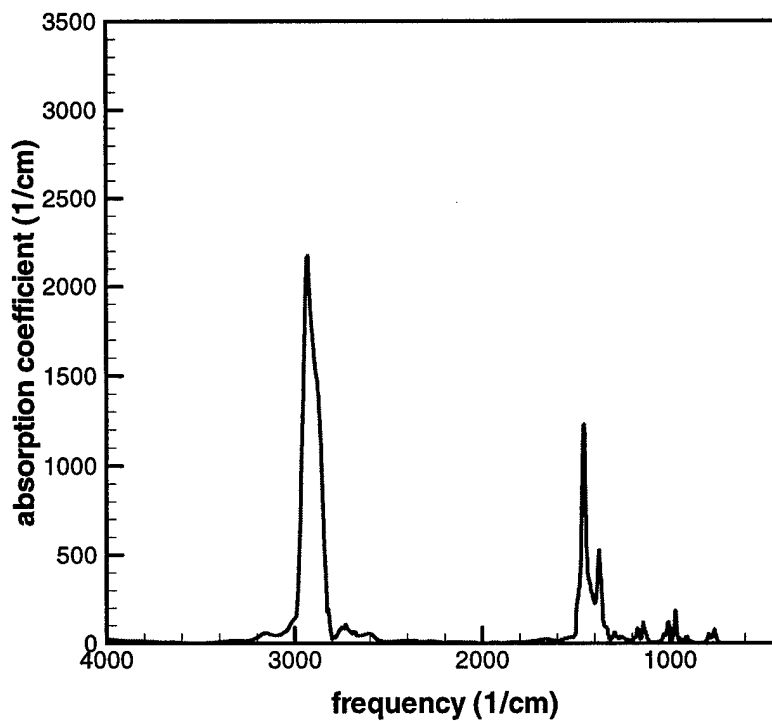


Figure 5.4 Absorption coefficient for iso-pentane

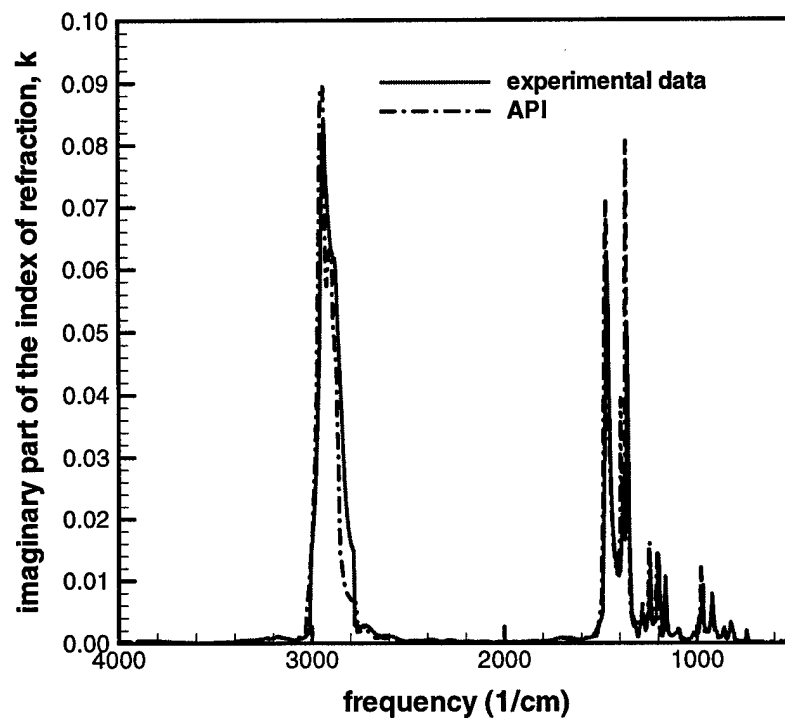


Figure 5.5 Extinction coefficient for iso-octane

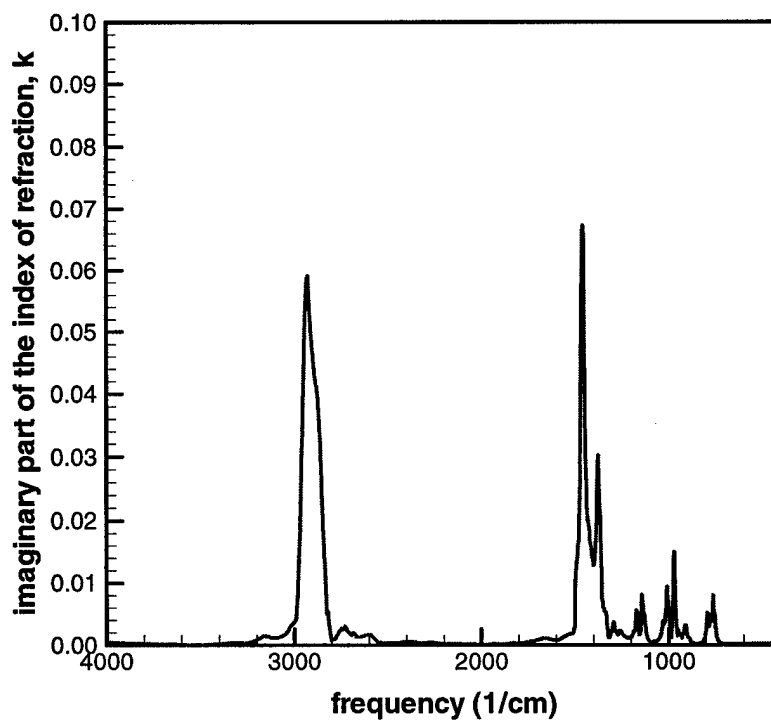


Figure 5.6 Extinction coefficient for iso-pentane

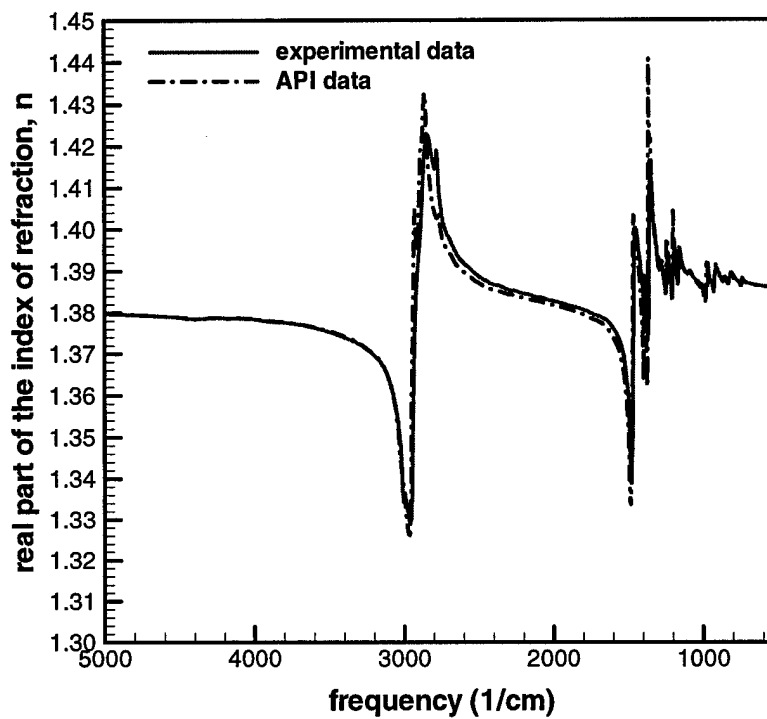


Figure 5.7 Real part of the index of refraction for iso-octane

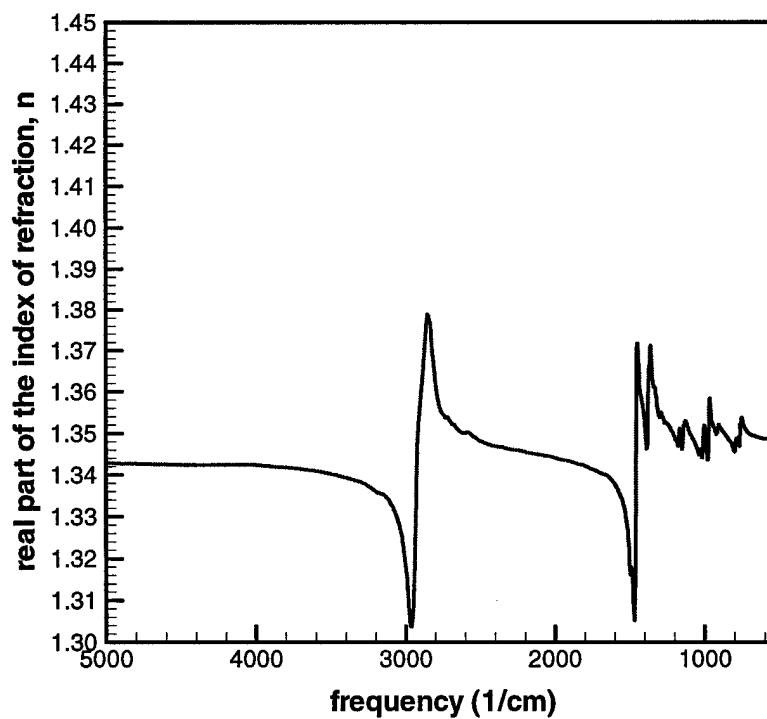


Figure 5.8 Real part of the index of refraction for iso-pentane

experimental data. Across the experimental spectrum, there is good agreement for iso-octane between the experimental data and the API data. At $3.39 \mu\text{m}$ (2950 cm^{-1}), there is good agreement (less than 4% difference) with the determined values of the refractive index, n , between the experiment and the API results. The absorption coefficient, α , and the extinction coefficient, k , determined in the experiment closely agree with the values obtained by Drallmeier and Peters [5]. The absorption coefficient and the extinction coefficient both differ by approximately 5%.

The experimental data was unable to accurately show the doublet structure found in paraffin fuels in the absorption band located at $3000\text{-}2800 \text{ cm}^{-1}$ ($3.33\text{-}3.57 \mu\text{m}$). This is due to a combination of three factors. First the size of the bandwidth produces a spectral slit width that is too large to accurately detect the fine structure of the transmittance curve. Second, the signal to noise ratio may be too low to accurately measure the intensity of the radiant beam. Lastly, the averaging technique used to counter the interference effect on the thin cells may have reduced the accuracy of the empty cell intensity value.

The absorption band between 3000 and 2800 cm^{-1} ($3.33\text{-}3.57 \mu\text{m}$) may be under determined by as much as 20%, as compared with API data. In the longer wavelength regions, an underestimation of the absorption band can produce a larger error in the value of the extinction coefficient. This can be seen in Figure 5.5. The strength of the narrow absorption between $1400\text{-}1340 \text{ cm}^{-1}$ ($7.14\text{-}7.46 \mu\text{m}$) may be under-measured by as much as 50%. This can cause a significantly lower value for the extinction coefficient because of the smaller value for the frequency used in the calculation. The under determination can be caused by the same reasons which reduced the ability to accurately measure the

narrow absorption bands and can also be caused by errors in cell width. The estimated tolerance on the teflon spacers smaller than 0.1 mm is $\pm 20\%$. If the spacer is greater than the accepted value of 0.015 mm, the absorption coefficient will be under determined.

As shown for water, the real part of the index of refraction is less sensitive to the accuracy of transmittance measurements. Since data outside the experimental data range was available from the API for iso-octane, it was used in the Kramers-Kronig analysis.

Table 5.2 Comparison of results for iso-octane at 3.39 μm

Fuel	absorption coefficient, α (cm^{-1})	extinction coefficient, k	refractive index, n
Experiment	2573	0.0695	1.336
API	3311	0.0895	1.384
Drallmeier & Peters [5]	2447	0.066	1.44

The regions outside the experimental data region for iso-pentane were modeled after iso-octane since no other data was available. The only difference was that the absorption coefficient was assumed to be constant from 700-10 cm^{-1} (14.28-1000 μm) instead of 400-10 cm^{-1} (25-1000 μm), as in the case of iso-octane, since API data was available out to 400 cm^{-1} . For the region of 5000-4000 cm^{-1} (2-2.5 μm), API data was used for iso-octane and the same data was used for iso-pentane because of the similarities in molecular structure between the two compounds.

5.1.2 Normal Paraffins. The results for the normal paraffin fuels (n-hexane, n-heptane, n-nonane, and n-decane) are presented in Figures 5.9 through 5.24. The transmittance curves are presented in Figures 5.9 through 5.12. The absorption coefficients are shown in Figures 5.13 through 5.16, the extinction coefficients are presented in Figures 5.17 through 5.20, and the real part of the index of refraction is shown in Figures 5.21 through 5.24. As expected, the absorption coefficients and extinction coefficients are very similar for all four of the fuels in this group. This is due to the close molecular structure similarity of all four of the fuels. These fuels are less absorbing across the experimental data range as compared to iso-octane and iso-pentane. The straight chain bond structure of the normal paraffin fuels is less absorbing than the more compact carbon bonding of the iso-octane and iso-pentane molecules.

5.2 OLEFIN

The results for the olefin examined in this study, 1-hexene, are presented in Figures 5.25 through 5.28. The transmittance curve is shown in Figure 5.25. The absorption coefficient and extinction coefficient is shown in Figure 5.26 and 5.27 respectively. The real part of the index of refraction is presented in Figure 5.28. Like iso-pentane, transmittance measurements were difficult to obtain for 1-hexene because of its high vapor pressure. Additionally, 1-hexene required extra precautions for proper ventilation because of the inhalation dangers caused by its fumes.

1-Hexene has two very strong absorption bands of almost equal strength. The first is located between $3000 - 2900 \text{ cm}^{-1}$ ($3.33 - 3.45 \text{ }\mu\text{m}$),. The second is centered at

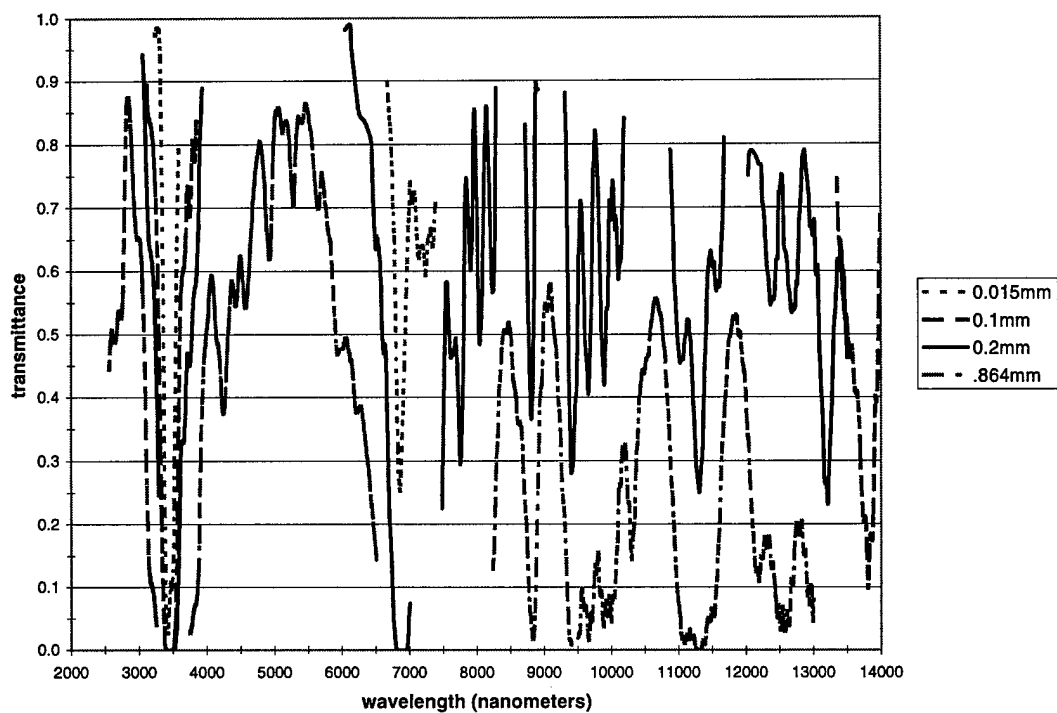


Figure 5.9 Transmittance of n-hexane

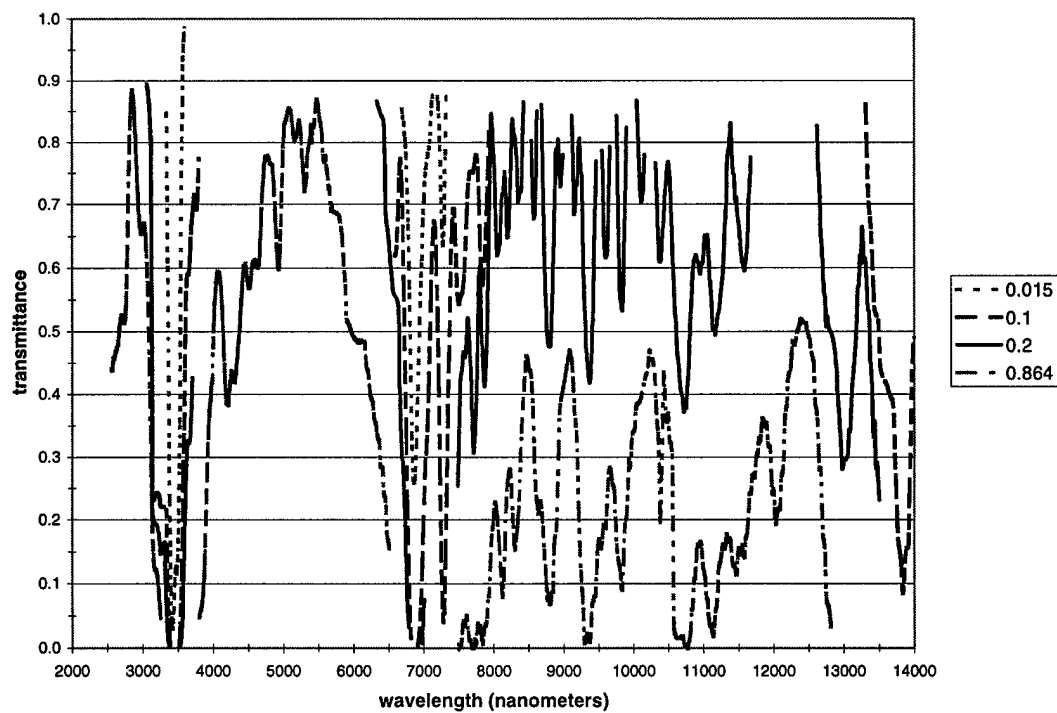


Figure 5.10 Transmittance of n-heptane

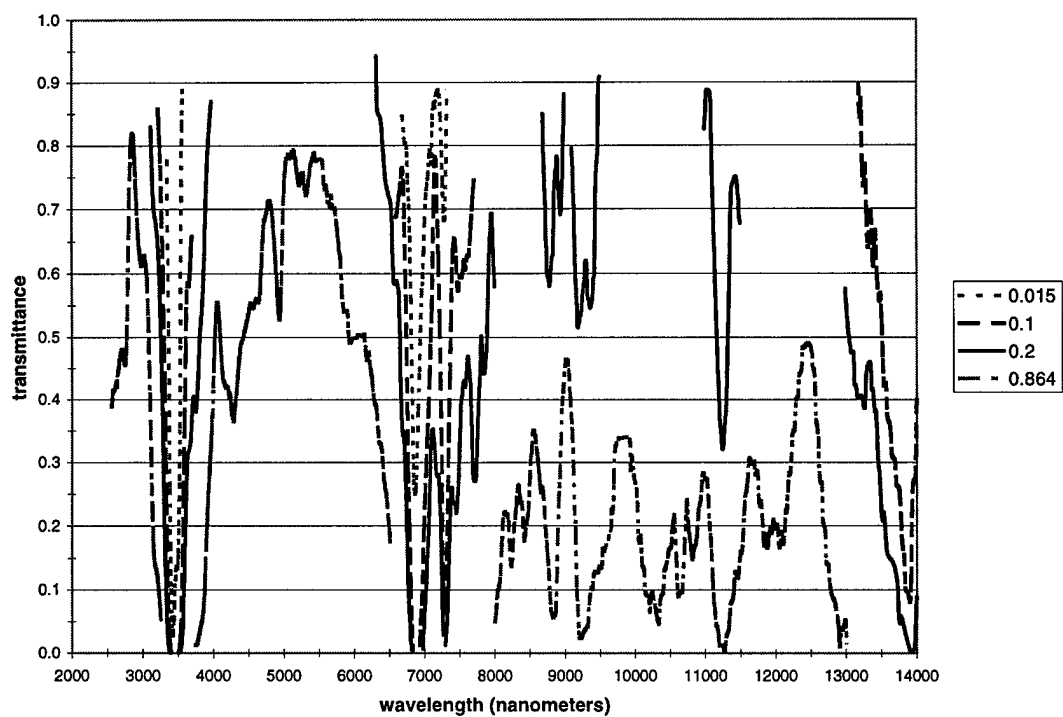


Figure 5.11 Transmittance of n-nonane

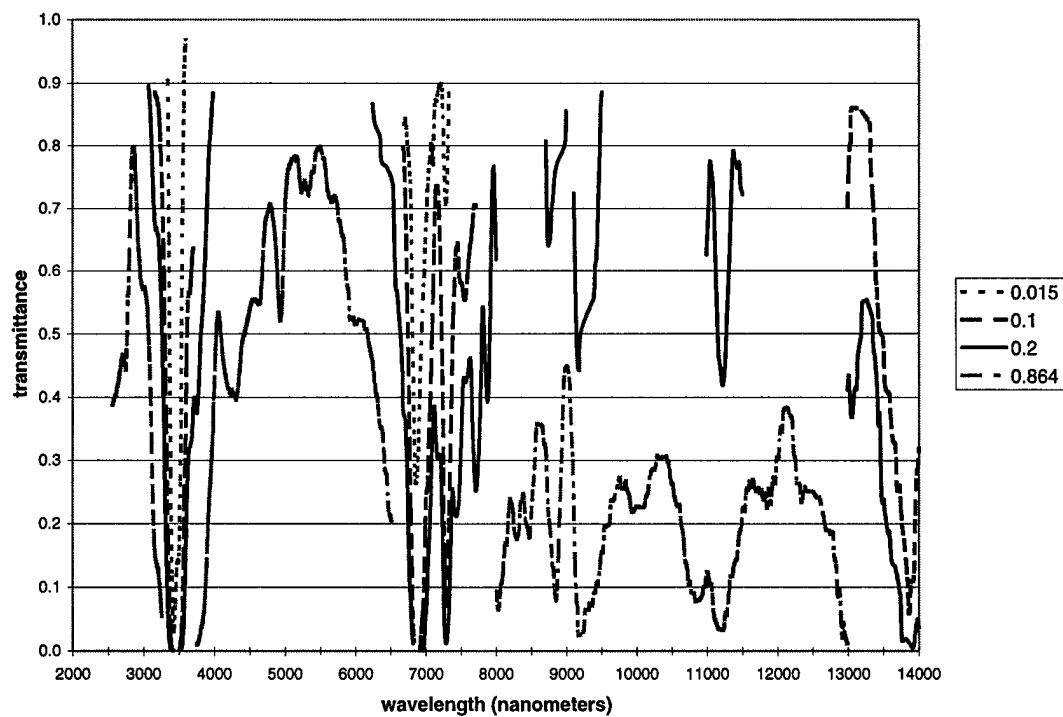


Figure 5.12 Transmittance of n-decane

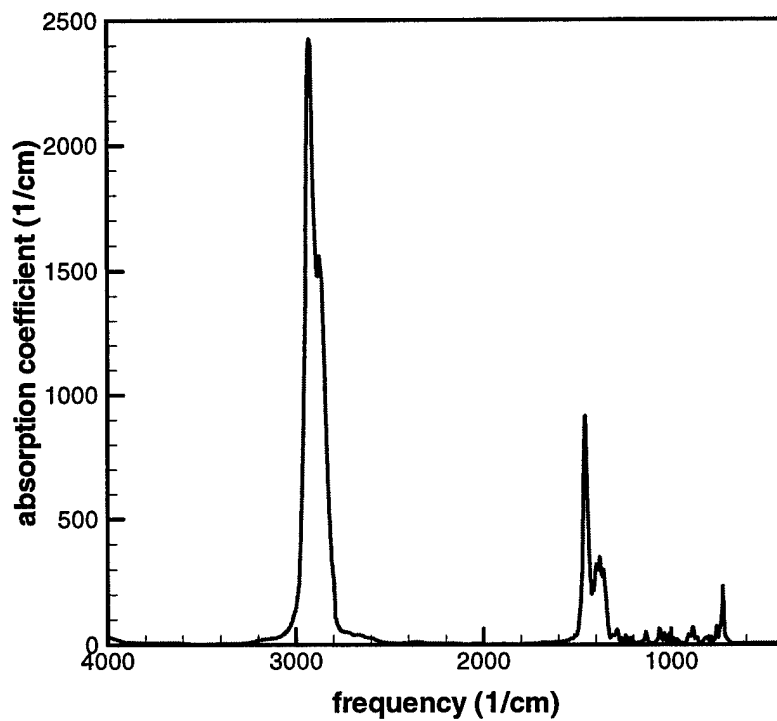


Figure 5.13 Absorption coefficient for n-hexane

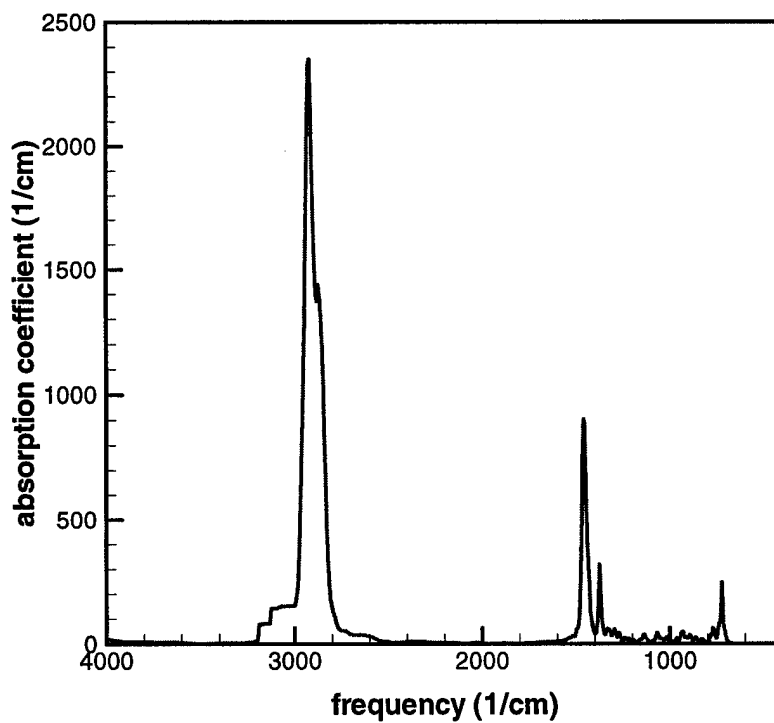


Figure 5.14 Absorption coefficient for n-heptane

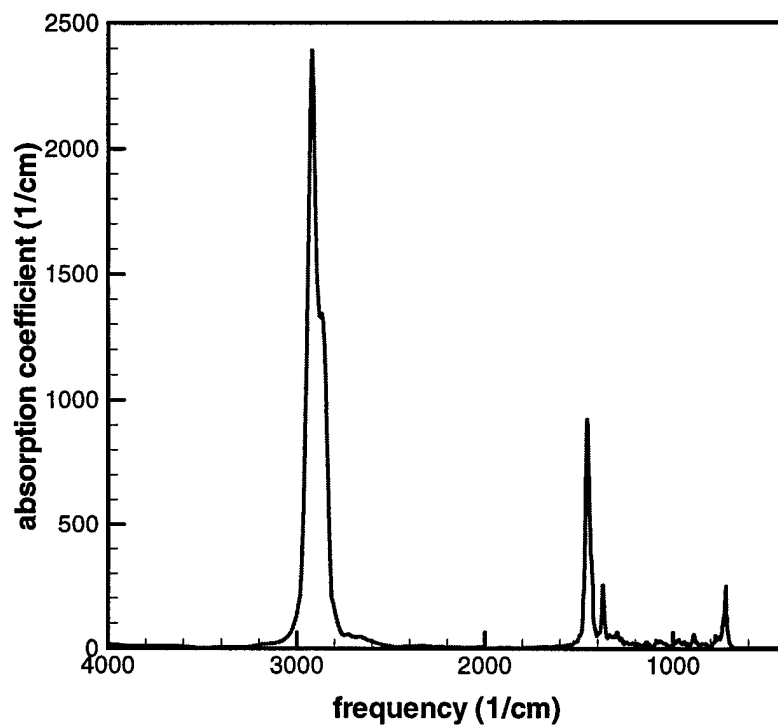


Figure 5.15 Absorption coefficient for n-nonane

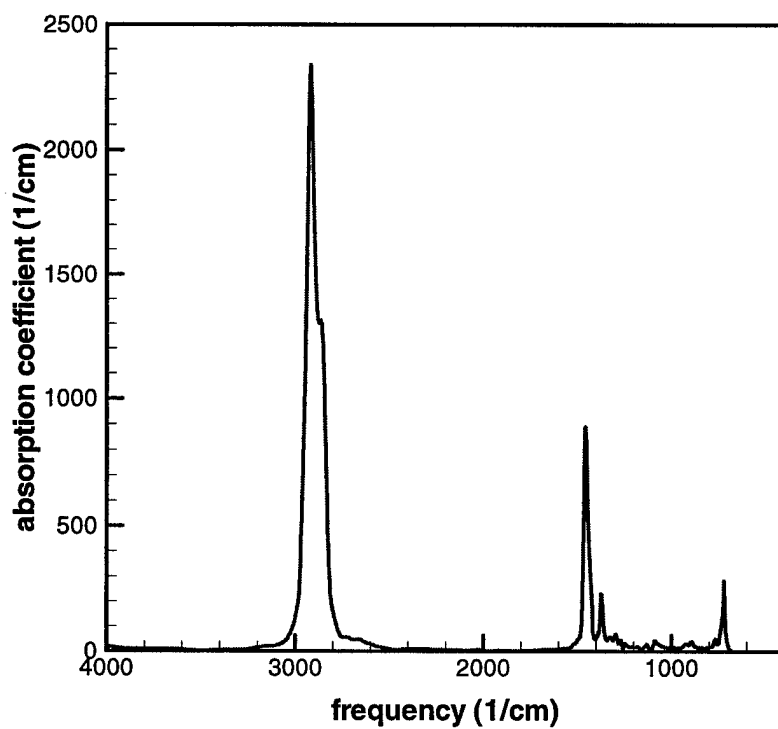


Figure 5.16 Absorption coefficient for n-decane

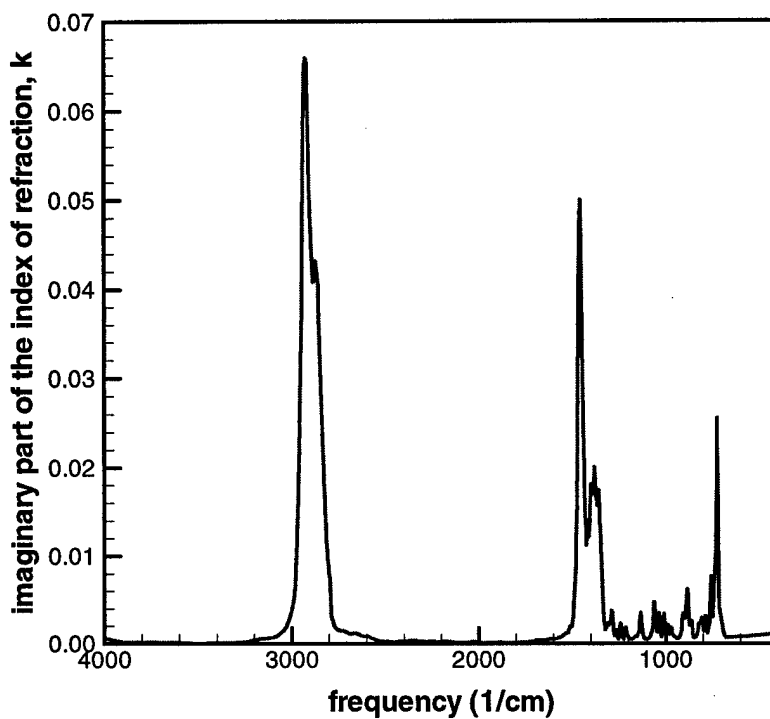


Figure 5.17 Extinction coefficient n-hexane

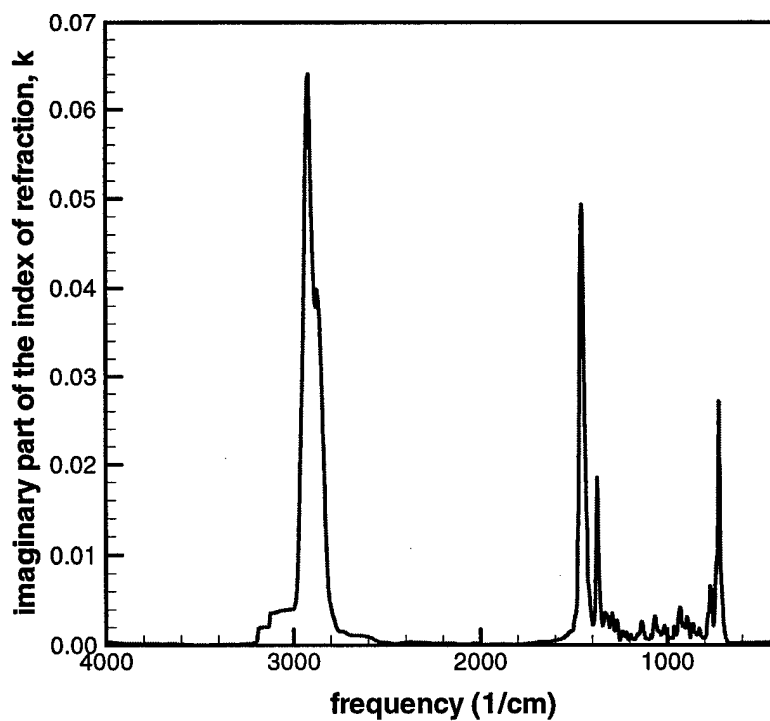


Figure 5.18 Extinction coefficient for n-heptane

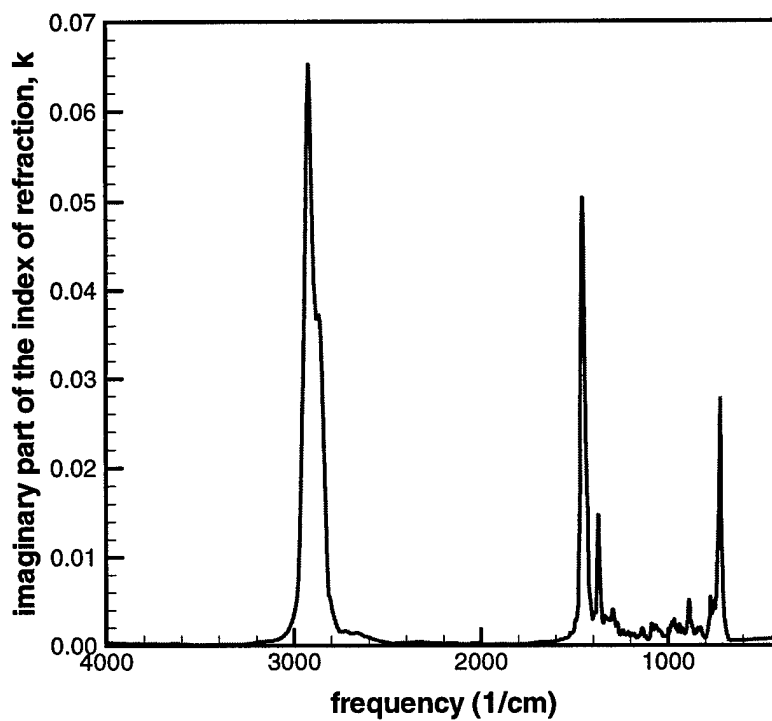


Figure 5.19 Extinction coefficient for n-nonane

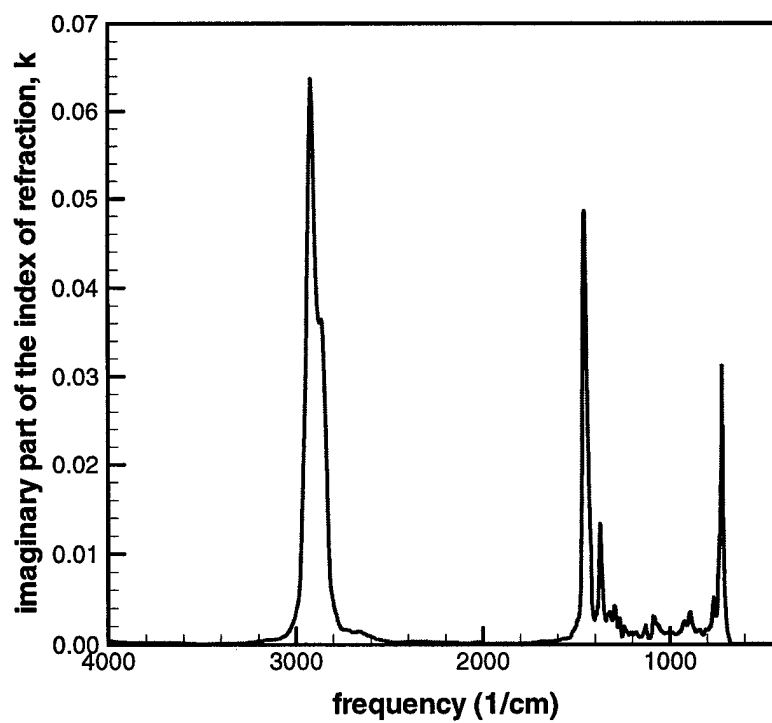


Figure 5.20 Extinction coefficient for n-decane

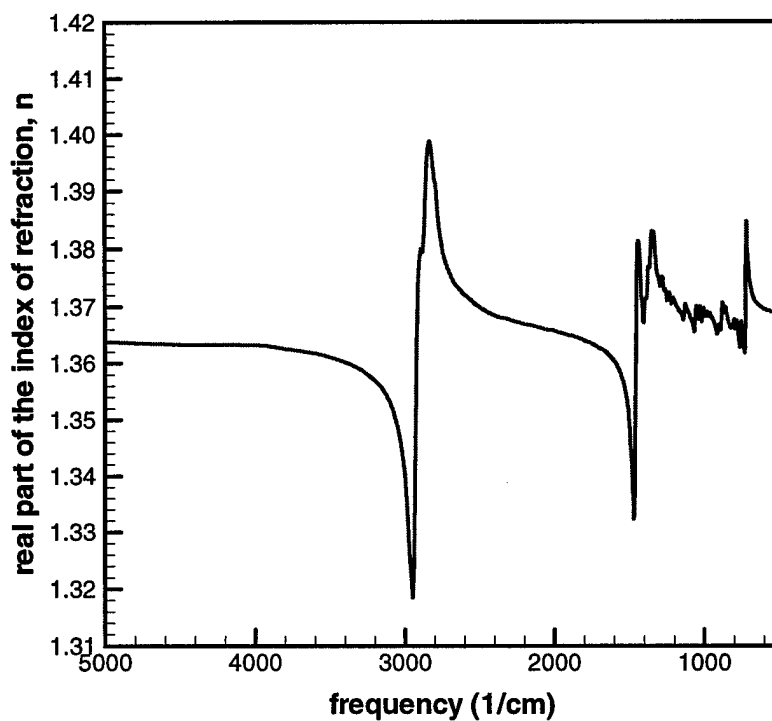


Figure 5.21 Real part of the index of refraction for n-hexane

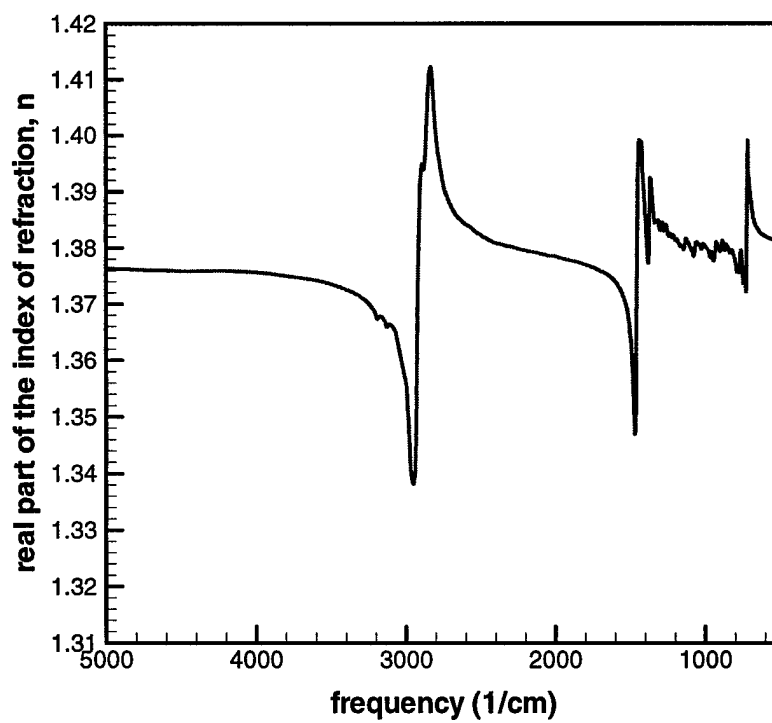


Figure 5.22 Real part of the index of refraction for n-heptane

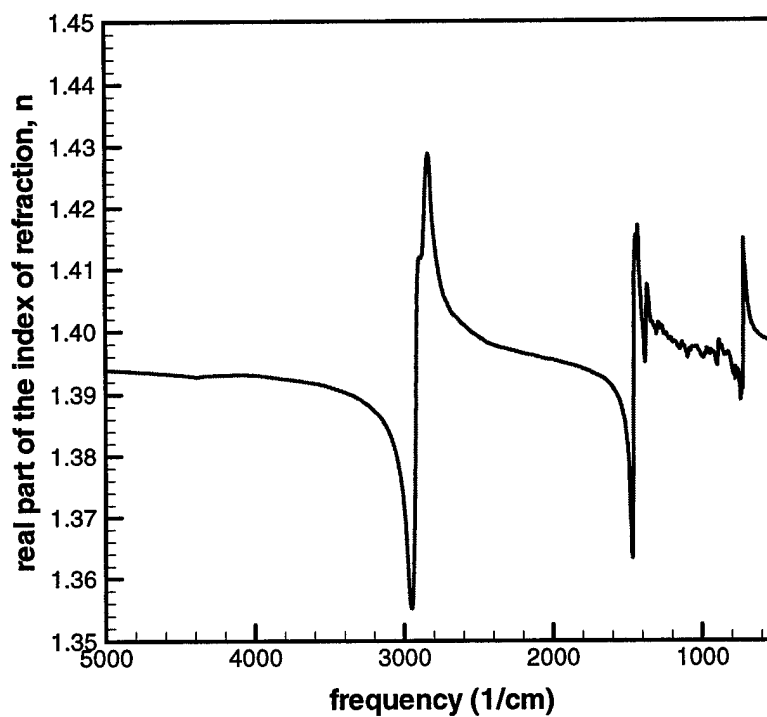


Figure 5.23 Real part of the index of refraction for n-nonane

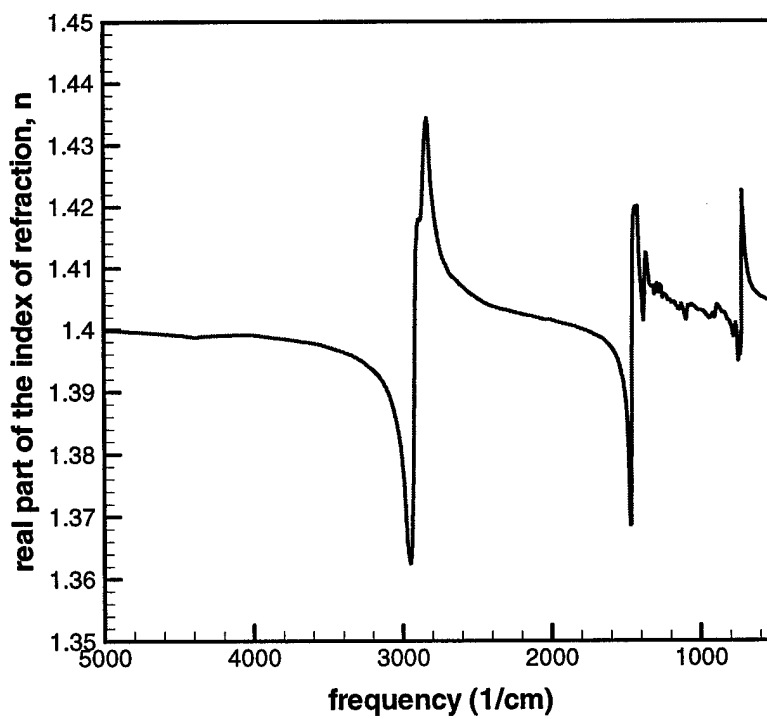


Figure 5.24 Real part of the index of refraction for n-decane

910 cm^{-1} (10.99 μm). This second absorption band produces an extinction coefficient that is almost three times greater than the extinction coefficient caused from the first absorption band. The large extinction coefficient causes a relatively large change in the value of the real part of the refractive index.

5.3 AROMATIC

The results for the aromatic fuels, o-xylene and toluene, are presented in Figures 5.29 through 5.36. The transmittance curves are shown in Figures 5.29 and 5.30. The absorption coefficients and extinction coefficients are shown in Figures 5.31 and 5.32. The real part of the index of refraction is presented in Figures 5.33 and 5.34.

Because of insufficient beam intensity at the far end of the experimental data range, the strongest absorption bands for both of the aromatic fuels could not be measured. The o-xylene absorption band located at 741 cm^{-1} (13.50 μm) and the toluene absorption band located at 728 cm^{-1} (13.75 μm) were approximated using the API data as a guide. The absorption coefficient could not directly calculated from the API data since the transmittance level was recorded as zero at the peaks of both of these absorption bands. To approximate the strength of the bands, a transmittance value of 0.0001 was assigned to the experimental data at the center of each of these absorption bands. This produced an absorption coefficient of just over 6000 cm^{-1} , and an extinction coefficient of over 0.6.

Toluene has another very strong absorption band that is outside the experimental data region, located at 465 cm^{-1} (21.50 μm). The API data was used to determine the absorption coefficient at this location. The data was included in the spectrum used to

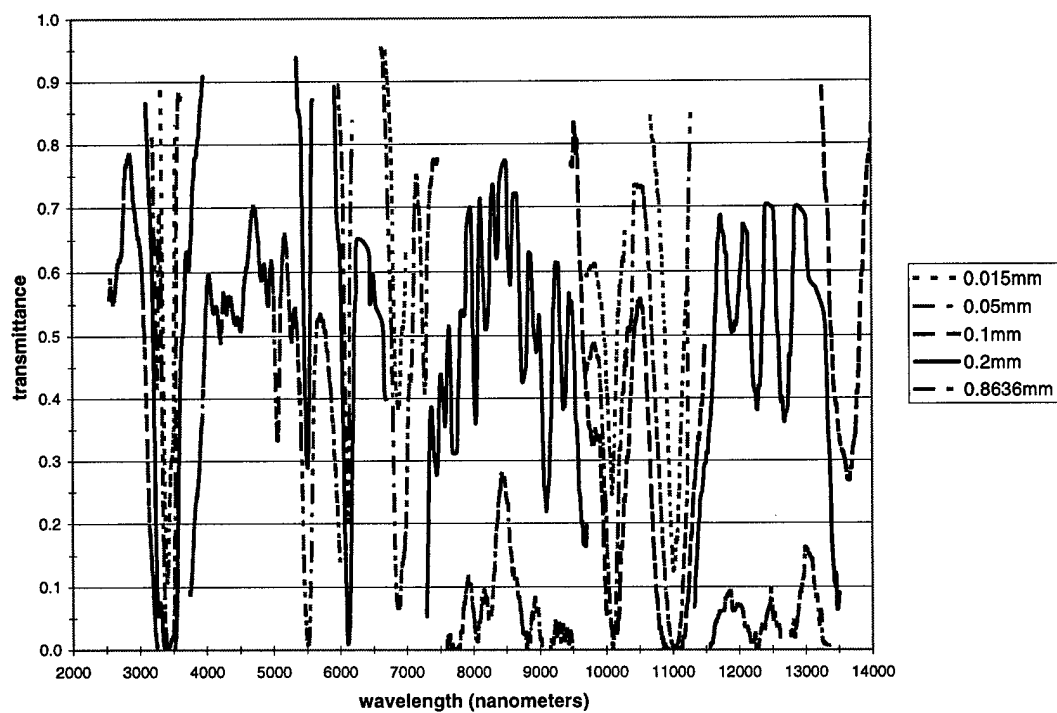


Figure 5.25 Transmittance of 1-hexene

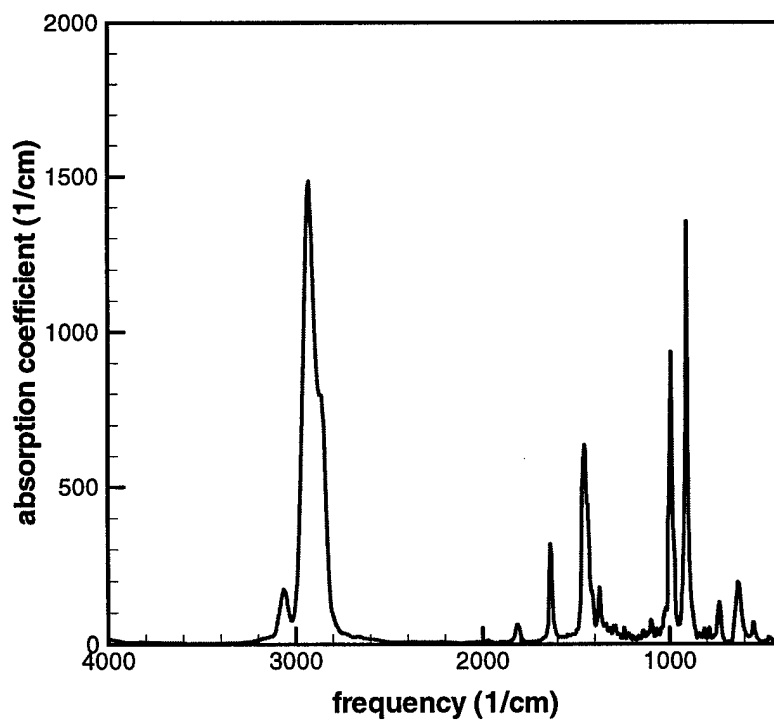


Figure 5.26 Absorption coefficient for 1-hexene

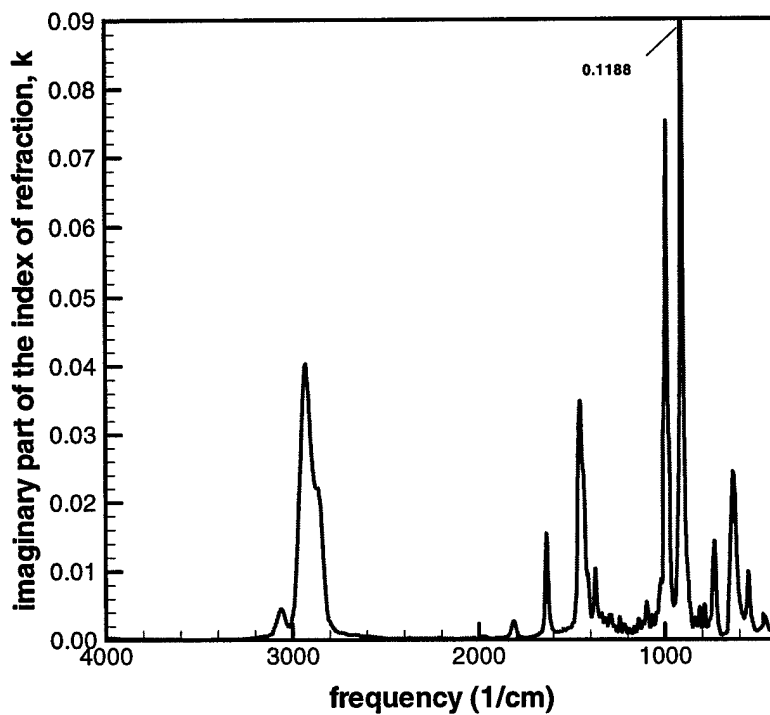


Figure 5.27 Extinction coefficient for 1-hexene

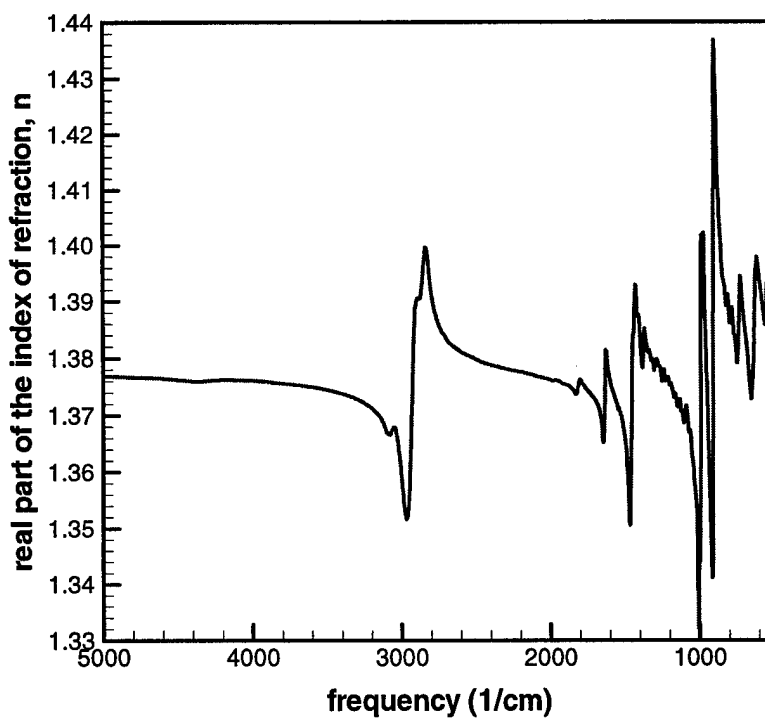


Figure 5.28 Real part of the index of refraction for 1-hexene

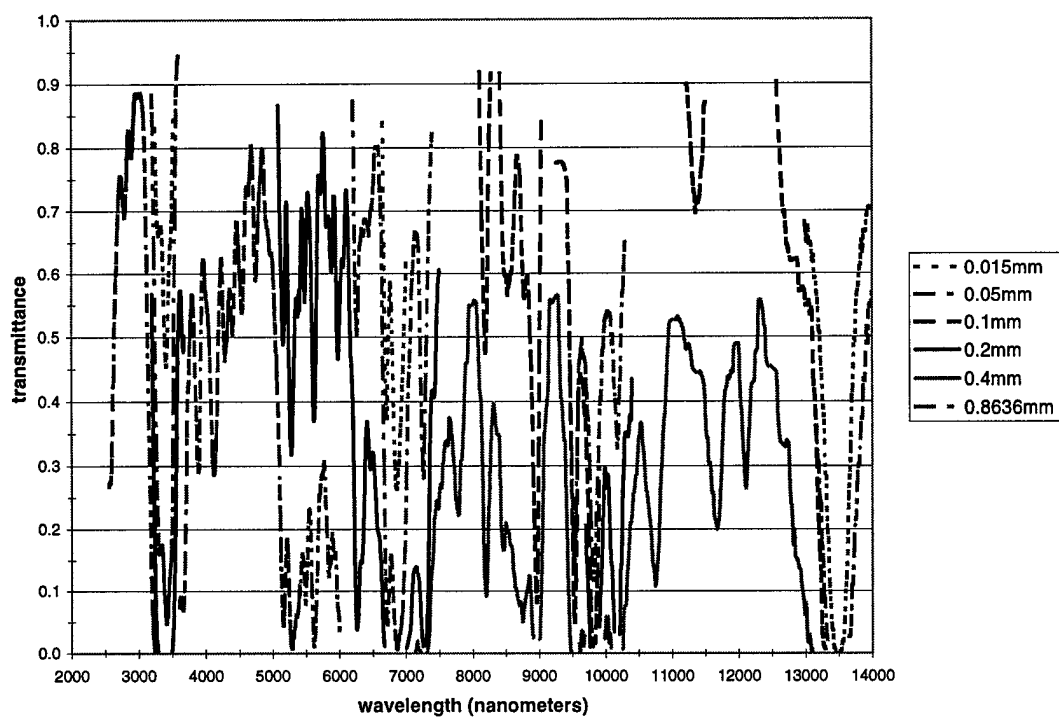


Figure 5.29 Transmittance of o-xylene

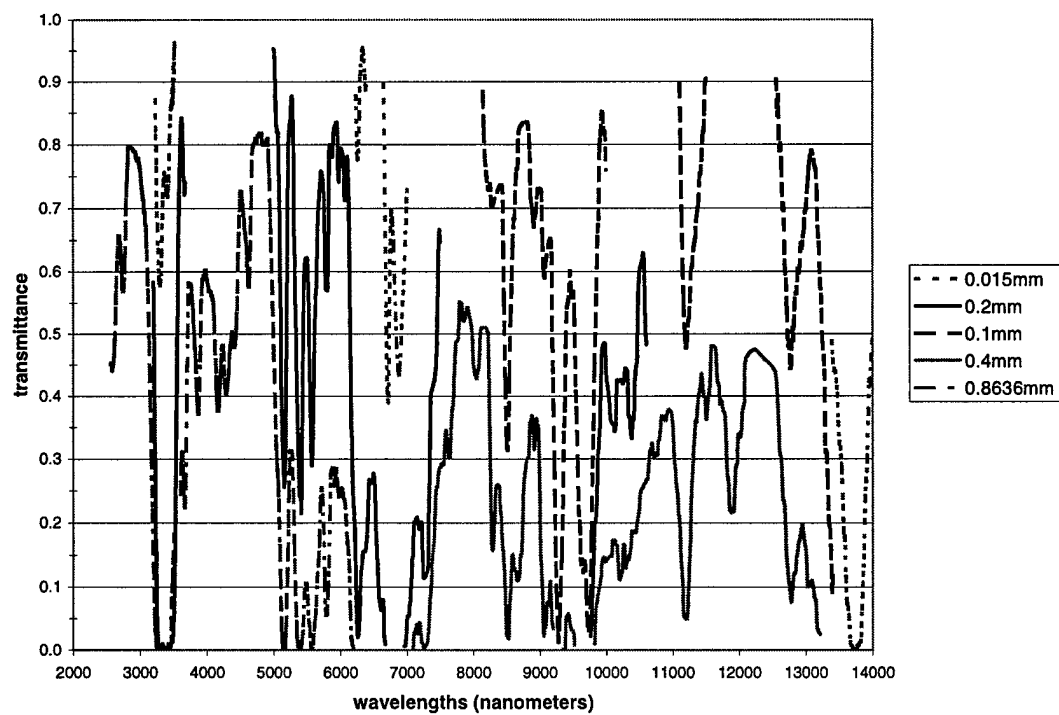


Figure 5.30 Transmittance of toluene

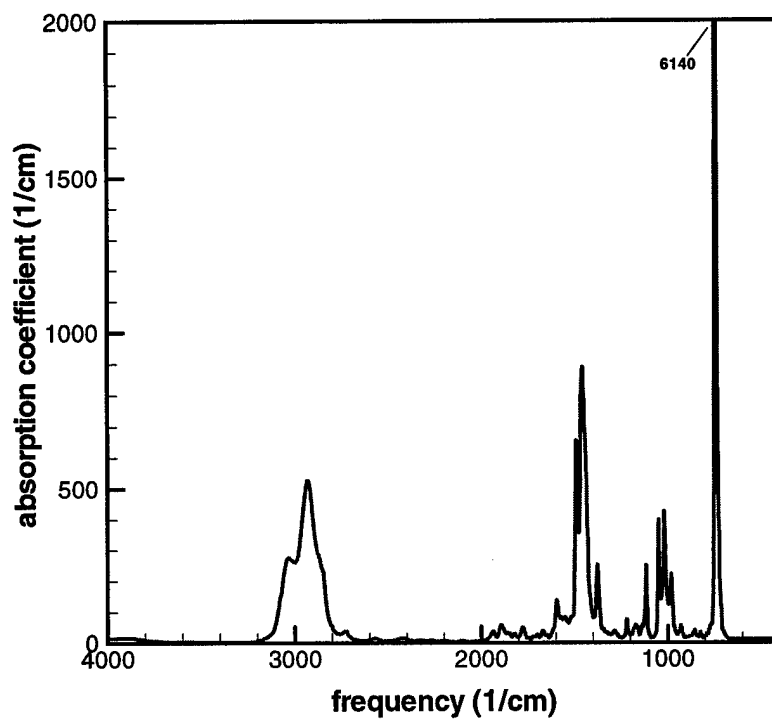


Figure 5.31 Absorption coefficient for o-xylene

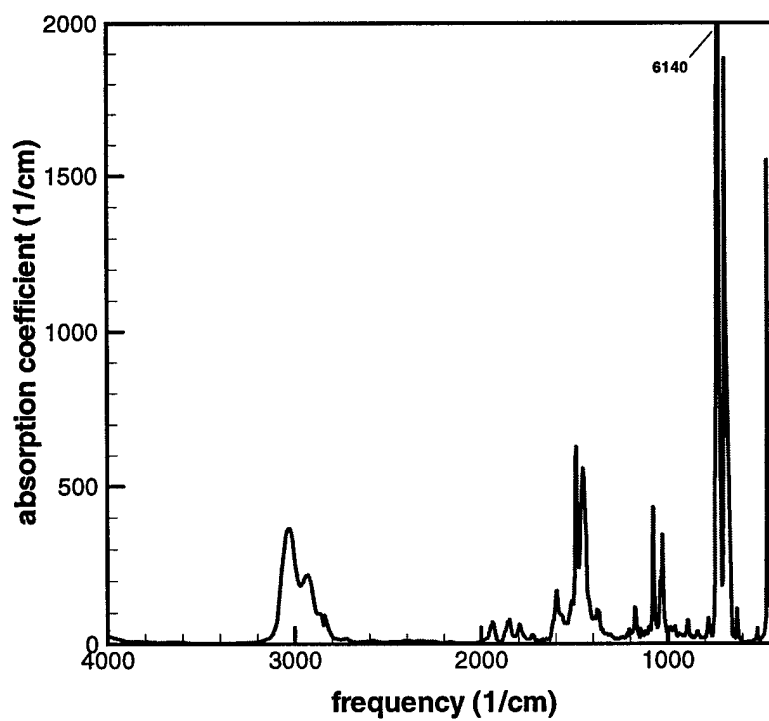


Figure 5.32 Absorption coefficient for toluene

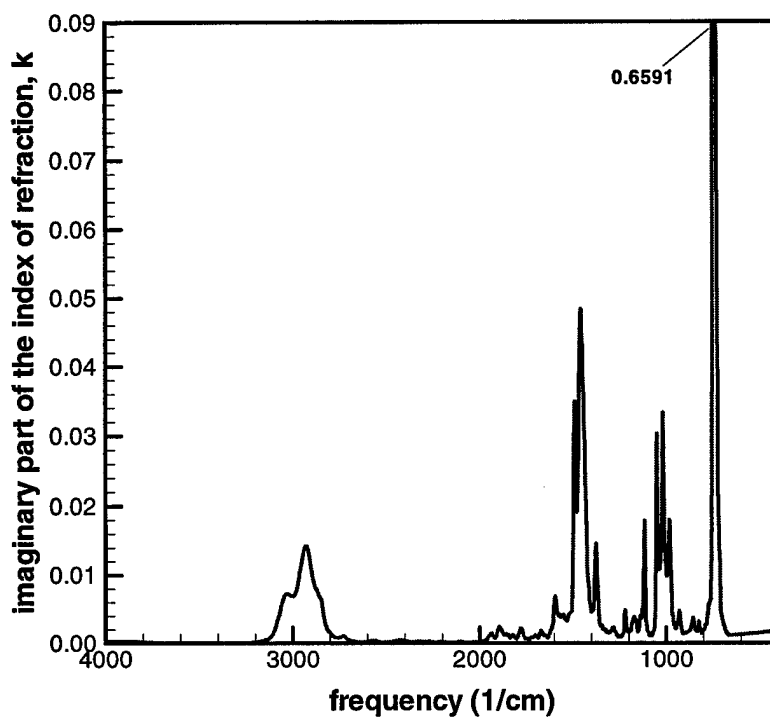


Figure 5.33 Extinction coefficient for o-xylene

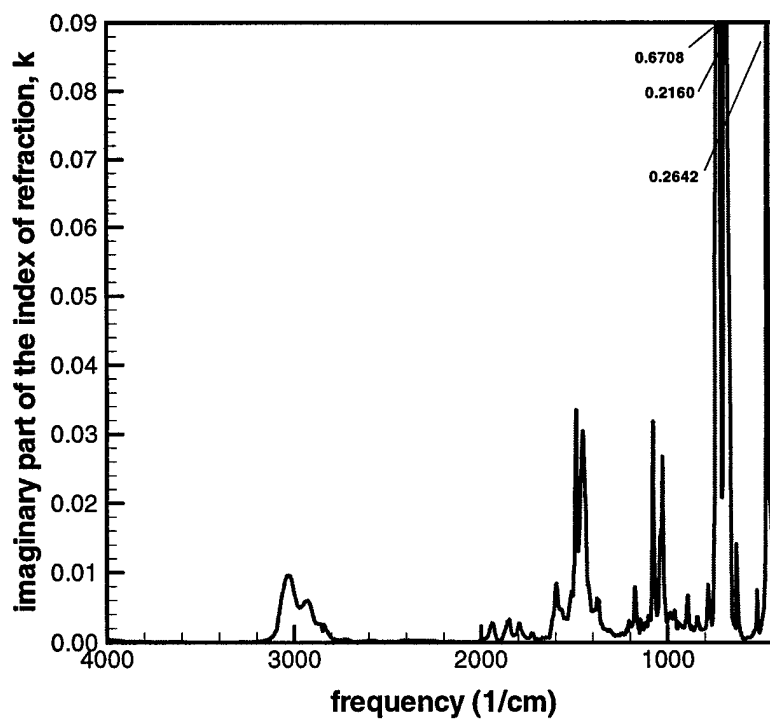


Figure 5.34 Extinction coefficient for toluene

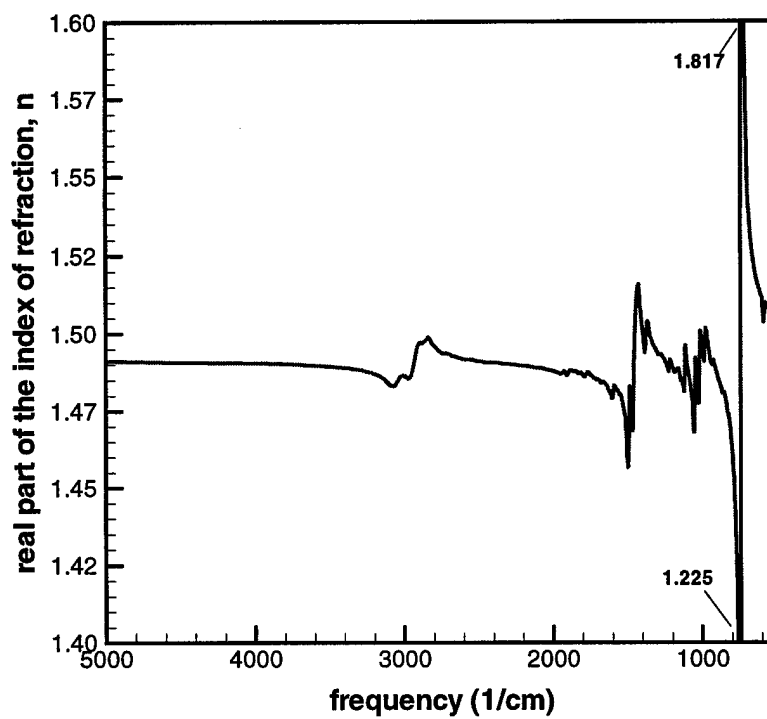


Figure 5.35 Real part of the index of refraction for o-xylene

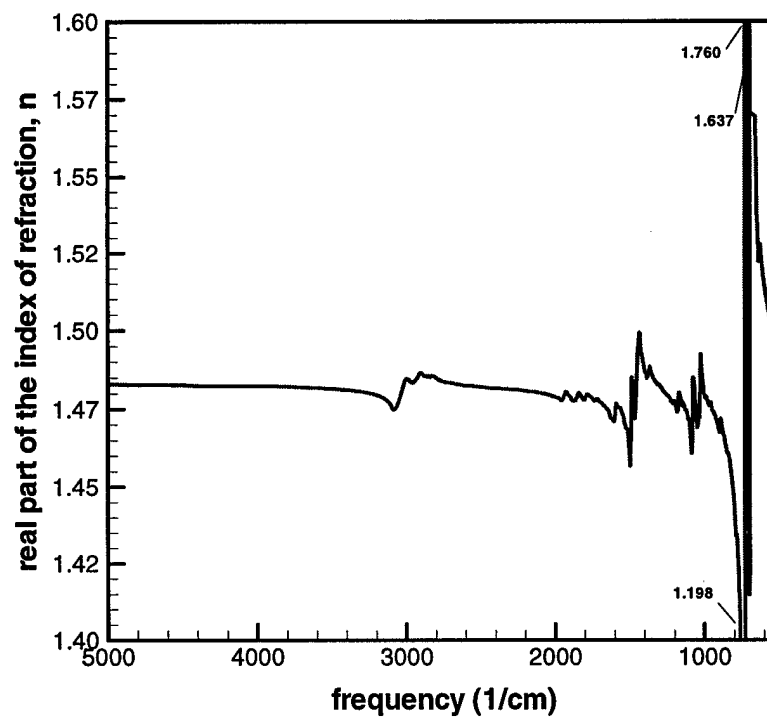


Figure 5.36 Real part of the index of refraction for toluene

calculate the value of the real part of the refractive index because it produces a significant fluctuation. This demonstrates how absorption bands at low frequencies more significantly affect the real part of the index of refraction versus the affect of a same strength absorption band at higher frequencies.

6. CONCLUSIONS AND RECOMMENDATIONS

The optical constants have been determined for nine single component hydrocarbon fuels in the infrared region of 2.0-15.0 μm (5000-667 cm^{-1}). An experimental protocol has been developed that can be used to determine infrared optical constants of other liquids at a later date. Comparisons to existing quantitative data showed that the extinction coefficient for iso-octane is in excellent agreement with the value determined by Drallmeier and Peters [5] at 3.39 μm (2950 cm^{-1}). The 5% difference between the values further validates the experimental results beyond the validation done with water. This close agreement increases the confidence of the experimental results since, in areas of strong absorption, reflectance measurements can generally produce more accurate results than transmittance measurements. The absorption coefficient curve for iso-octane matches very well with the curve produced from API data. This shows that the experimental set-up was properly aligned.

Comparisons with the API data shows that the absorption coefficient may be under determined by as much as 20% in high frequency regions and as much as 50% in the lower frequency regions. This is primarily due to the size of the spectral slit width used on the monochromator, but the accuracy of the thin teflon spacers can also significantly impact the experimental results. The 20% estimated uncertainty in the thin spacers allows for a large error range in the experimental results in the vicinity of the strong absorption bands.

The experiment highlights the difficulty in accurately measuring weak infrared signals and the continuous balance that must be achieved between spectral slit width size and signal to noise ratio. The bandwidth used in the experiment was reduced to the

smallest size that could still produce an acceptable signal to noise ratio. At high frequencies, an under determination in the absorption coefficient will produce a similar under determination in the extinction coefficient. However, at low frequencies, the extinction coefficient will be significantly more underdetermined if the strength of the absorption band is under measured.

Since the extinction coefficient is used in determining the drop optical thickness in laser extinction techniques, the use of an extinction laser in the high frequency range of the infrared spectrum is recommended. The values at $3.39 \mu\text{m}$ (2950 cm^{-1}) were of particular interest since they can be used in current laser extinction technique experiments. For most hydrocarbon fuels, the strongest absorption band is located in the higher frequency region of the infrared. Although the strongest absorption band for the aromatic fuels is located in the low frequency region, the absorption band located between $3075 - 2855 \text{ cm}^{-1}$ ($3.25\text{-}3.50 \mu\text{m}$) is sufficiently strong enough for use with the laser extinction technique. Additionally, because of a better signal to noise ratio that was present at the higher frequency (lower wavelength) region, the confidence in the values of the determined extinction coefficients at this location is much greater.

Because the real part of the index of refraction is less sensitive to an under measurement of the strength of an absorption band, the estimated error in the results is less than 5% in the high frequency region. This amount of accuracy is more than satisfactory for Mie theory calculations. Two factors show the most influence on the calculation of the real part of the index of refraction. First, the location in the infrared spectrum of strong absorption bands. If the location of the bands is not properly determined, i.e., the location is shifted slightly, the large changes in the value of the real

part of the index of refraction will also shift. Also, strong absorption bands in the lower frequency (higher wavelength) regions have a greater impact than absorption bands in the high frequency regions. Second, the reference value chosen to converge the Kramers-Kronig calculation. If the value is located in an absorption band, the Kramers-Kronig method will produce erratic results that do not physically make sense, e.g., a negative value. If the accuracy of the reference value is poor, this error is passed directly onto the calculations, causing all of the values to be either too high or too low.

The current experimental set-up produced excellent results in low absorbing regions. In highly absorbing regions, the results are satisfactory, but improvements made to increase the accuracy of the measurements will further increase the confidence of the results. Since hydrocarbon fuels possess many narrow strong absorption bands in various locations throughout the infrared spectrum, a smaller bandwidth on the monochromator will increase the accuracy of the measured strength of these narrow absorption bands. Simply decreasing the resolution between measurements will have no affect if the resolution size is smaller than the bandwidth. The larger the bandwidth, the larger the available spectral slit width for each scan. Decreasing the spectral slit width will increase the accuracy of the resolution of the monochromator. Unfortunately, size of bandwidth has a dramatic impact on the magnitude of the intensity of the radiant beam. To achieve a smaller bandwidth and still maintain a good signal to noise ratio, some minor changes must be made to the experimental set-up.

The first option would be to replace the globar in the monochromator illuminator with one that emits more intensity. An Oriel 6363 140-watt emitter produces irradiance that is two orders of magnitude greater than the 9-watt globar used in the illuminator.

Using this new globar would require a different monochromator illuminator. The current illuminator can not provide the required power for a globar that can emit more intensity. An Oriel 60963 monochromator illuminator is required to power the 6363 emitter.

A second option would be to replace the monochromator illuminator with an Oriel 80007 modular silicon carbide infrared light source. Figure 6.1 shows the schematic of the recommended changes for this option. The silicon carbide source is designed to provide an infrared source to an FTIR spectrometer. The irradiance of this glower is the same as the globar in the current illuminator. The improvement in intensity comes from the parabolic reflector inside the silicon carbide source. Since the reflector allows the source to emit a collimated beam, the collimating optics can be removed from the experimental set-up. Approximately 50% of the radiant intensity is lost when the beam passes through the collimating optics (the AMTIR lens and the ZnSe lens both transmit about 70% of the radiation). Additionally, the overall distance of the light path can be decreased when the collimating optics are removed from the system. The decreased path length will result in an increased intensity at the infrared detector. The filter wheel and optical chopper have switched positions, but this will not affect the set-up as long as the filter wheel remains on the entrance side of the monochromator. The reason for the switch is to allow a vent for the light source. The sample cell is placed in between the light source and the monochromator. This allows the infrared detector to be placed adjacent to the exit opening of the monochromator. Also, by keeping the filter wheel before the sample cell, any effects of thermal heating continue to be minimized. These changes would produce a better signal to noise ratio and allow for a decreased bandwidth to be used across the experimental data range. Also, the silicon carbide source is half the

cost of a new monochromator illuminator mentioned in the first option. The new monochromator illuminator would still require collimating optics. The transmittance cut-off for the optics is very close to $15\ \mu\text{m}$. Without the collimating optics, enough signal intensity will be available to overcome the affect of the CO_2 atmospheric absorption band located at $14.95\ \mu\text{m}$ ($668\ \text{cm}^{-1}$).

A smaller teflon spacer, one which is half the thickness of the $0.015\ \text{mm}$ spacer will be required to accurately measure the strong absorption band for o-xylene and toluene located at $13.5\ \mu\text{m}$ and $13.75\ \mu\text{m}$ ($741\ \text{cm}^{-1}$ and $727\ \text{cm}^{-1}$), respectively. This spacer will have to be specially made, but it would provide higher transmittance and thus more reliable values at the strongest absorption bands.

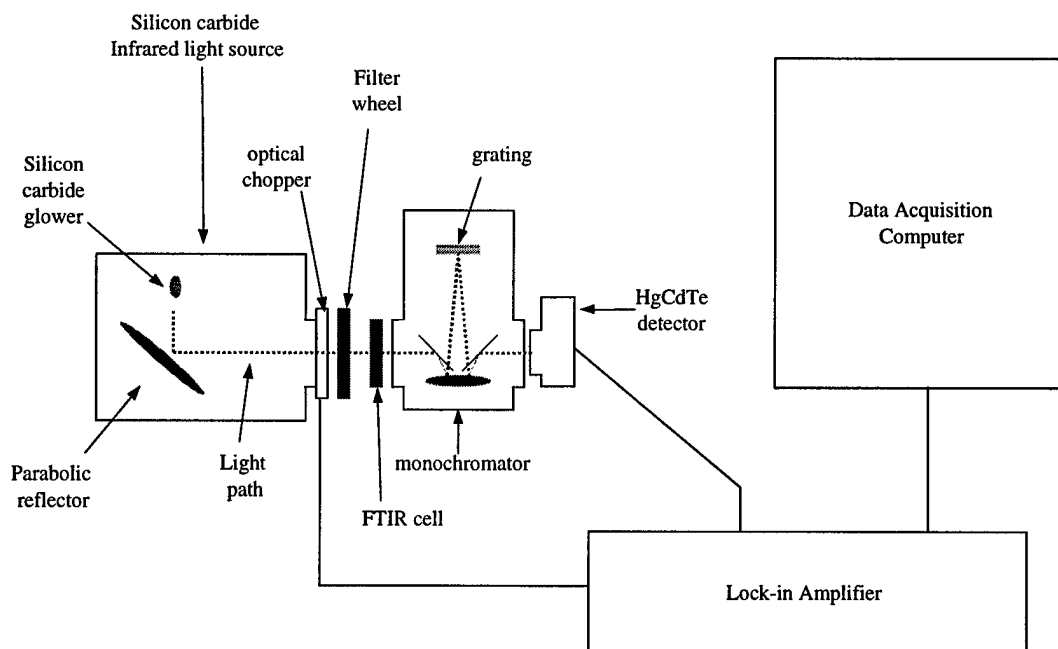


Figure 6.1 Schematic of recommended changes to experimental set-up

APPENDIX A.
COMPUTER PROGRAMS

Kramers-Kronig Program

This QuickBasic program calculates the real part of the index of refraction using absorption data.

```

'Kramers-Kronig Program
' Michael R. Anderson
' January 2000
' This program calculates the real part of the index of refraction, n, using
' the Kramers-Kronig method. the absorption coefficient must be known across the entire
' wavelength region. Data values are read in from low frequency to high frequency.

'
' Variable List
'ND          number of data points in experimental set
'w(I)        wavelength at point I
'a(I)        extinction coefficient at frequency w(I)
'n(I)        real coefficient at frequency w(I)
'F(I)        integrand value at frequency I
'Lower       contribution from lower wing
'Upper       contribution from upper wing
'delta       offset for the experimental upper and lower boundaries
'derr        derivative of a(I) wrt w(I)
'Ftotal      contribution from the experimental values
'constant    iterative constant
'wH          high end hypothetical frequency
'deln(I)     ultraviolet adjustment to n(I)

'
' MAIN PROGRAM
DEFDBL A-Z
CLS
wH = 100000
constant = .3926
delta = .00001
pi = 3.141592653589793#
DIM w(5000), a(5000), n(5000), F(5000)
DIM deln(5000)
D$ = "c:\Anderson\thesis\octanea.txt"
B$ = "c:\Anderson\thesis\omegaoct.txt"
OPEN D$ FOR INPUT AS #3:'absorption coefficient values
OPEN B$ FOR INPUT AS #2:'frequencies which correspond to absorption coefficients
z = 1
WHILE NOT EOF(2)
    INPUT #2, w(z)
    INPUT #3, a(z)
    z = z + 1
WEND
CLOSE #2
CLOSE #3
E$ = "c:\Anderson\thesis\octane.txt"
OPEN E$ FOR OUTPUT AS #2
PRINT #2, "variables = "; CHR$(34) + "frequency" + CHR$(34); ", "; CHR$(34) + "n(v)" + CHR$(34); ", ";
CHR$(34) + "alpha" + CHR$(34)
nd = z - 1
n(2954) = 1.5
WHILE n(2954) > 1.404:' this is the data point at 16960 1/cm where you know the value of n for the fuel
FOR i = 1 TO nd
    GOSUB wing:'calculate wing contribution
    GOSUB trap:' calculate integrand contributions, F
    GOSUB real:' calculate real coefficient, n
NEXT i
constant = constant - .00005

```

```

WEND
      GOSUB results: ' output
CLOSE #2
END

wing:      ' wing contribution subroutine
      lower = (a(i) / (4 * (pi ^ 2) * w(i))) * LOG(((w(i) + w(1) + delta) / (w(i) - w(1) + delta)))
      upper = (a(i) / (4 * (pi ^ 2) * w(i))) * LOG(((w(nd) + delta) - w(i)) / ((w(nd) + delta) + w(i)))
RETURN

trap: 'F contributions
FOR j = 1 TO nd
  IF i = j AND i = 1 THEN
    GOSUB forward
  ELSEIF i = j AND i = nd THEN
    GOSUB backward
  ELSEIF i = j THEN
    GOSUB central
  ELSE
    F(j) = (a(j) - a(i)) / ((w(j)) ^ 2 - (w(i)) ^ 2)
  END IF
NEXT j
'perform trapezoidal rule
Ftotal = 0
FOR k = 1 TO nd
  Fpart = (F(k) + F(k + 1)) * (w(k + 1) - w(k)) / 2
  Ftotal = Ftotal + Fpart
NEXT k
RETURN

real: ' real index calculation
      correct = F(1) + F(nd)
      deln(i) = constant / (1 - (w(i) / wH) ^ 2)
      n(i) = 1 + deln(i) + lower + upper + (1 / (2 * pi ^ 2)) * (Ftotal + correct * delta)
RETURN

results: ' output results
FOR i = 1 TO nd
  PRINT #2, USING "#####.##  ###.#####  #####.#####"; w(i); n(i); a(i)
NEXT i
RETURN

forward: '
      derr = (a(i + 1) - a(i)) / (w(i + 1) - w(i))
      F(j) = (derr) / (2 * w(i))
RETURN

backward: '
      derr = (a(i) - a(i - 1)) / (w(i) - w(i - 1))
      F(j) = (derr) / (2 * w(i))
RETURN

central: '
      derr = (a(i + 1) - a(i - 1)) / (w(i + 1) - w(i - 1))
      F(j) = (derr) / (2 * w(i))
RETURN

```

Subtractive Kramers-Kronig Program

This QuickBasic program calculates the real part of the index of refraction using the subtractive Kramers-Kronig method.

```
'      Subtractive Kramers-Kronig Program
'      Michael R. Anderson
'      January 2000
```

```
'This program calculates the real part of the index of refraction, n, using
'the subtractive Kramers-Kronig method. A reference value for n must be known
'and the value of alpha, the absorption coefficient must be known across the entire
'wavelength region.
```

```
'      Variable List
'nd      number of data points in experimental set
'w(i)    wavelength at point i
'a(i)    absorption coefficient at frequency w(i)
'n(i)    real coefficient at frequency w(i)
'no      reference real coefficient
'wo      frequency of the reference coefficient
'ao      absorption coefficient at the reference frequency
'F(i)    integrand value at wavelength i
'E(i)    integrand value at wavelength i
'Lower   contribution from lower wing
'Upper   contribution from upper wing
'delta   offset for the experimental upper and lower boundaries
'correct correction term when the frequency is at the experimental boundary
'derr    derivative of a(i) wrt w(i)
'Ftotal  contribution from the experimental values
'Etotal  contribution from experimental values
```

MAIN PROGRAM

```
' dimension variables
DEFDBL A-Z
CLS
ao = 69.2
no = 1.303
wo = 5000
delta = .01
pi = 3.141592653589793#

DIM w(2000), a(2000), n(2000), F(2000), E(2000)

' input absorption coefficients and frequencies
D$ = "c:\Anderson\thesis\data\warob.txt"
B$ = "c:\Anderson\thesis\data\omega.txt"
OPEN D$ FOR INPUT AS #3
OPEN B$ FOR INPUT AS #2

z = 1
WHILE NOT EOF(2)
  INPUT #2, w(z)
  INPUT #3, a(z)
  z = z + 1
WEND

nd = z - 1
CLOSE #2
CLOSE #3
```

```

E$ = "c:\Anderson\thesis\data\wres6.txt"
OPEN E$ FOR OUTPUT AS #2
PRINT #2, "# frequency          n          alpha"

FOR i = 1 TO nd
  GOSUB wings: ' calculate wing contributions
  GOSUB integrand: ' calculate integrand contributions, F and E
  GOSUB calculate: ' calculate real coefficient, n
NEXT i

  GOSUB results: ' output
CLOSE #2
END

*****
wings: '      wing contribution subroutine
low1 = ((a(i) - a(1)) / (4 * w(i) * pi ^ 2)) * LOG(((w(i) + (w(1) - delta)) / (w(i) - (w(1) - delta))))
low2 = ((ao - a(1)) / (4 * w(i) * pi ^ 2)) * LOG(((wo + (w(1) - delta)) / (wo - (w(1) - delta))))
lower = low1 + low2
up1 = ((a(nd) - a(i)) / (4 * w(i) * pi ^ 2)) * LOG(((w(nd) + delta) - w(i)) / ((w(nd) + delta) + w(i)))
up2 = ((a(i) - ao) / (4 * w(i) * pi ^ 2)) * LOG(((w(nd) + delta) - wo) / ((w(nd) + delta) + wo))
upper = up1 + up2
RETURN

*****
integrand: '      F and E contributions
FOR j = 1 TO nd
  IF i = j AND i = 1 THEN
    GOSUB forward
  ELSEIF i = j AND i = nd THEN
    GOSUB backward
  ELSEIF i = j THEN
    GOSUB central
  ELSE
    F(j) = (a(j) - a(i)) / ((w(j)) ^ 2 - (w(i)) ^ 2)
  END IF

  IF w(j) = wo THEN
    GOSUB exception
  ELSE
    E(j) = (a(j) - ao) / ((w(j)) ^ 2 - (wo ^ 2))
  END IF
NEXT j

'      perform trapezoidal rule
Ftotal = 0
Etotal = 0

FOR h = 1 TO (nd - 1)
  Fpart = (F(h) + F(h + 1)) * (w(h + 1) - w(h)) / 2
  Epart = (E(h) + E(h + 1)) * (w(h + 1) - w(h)) / 2
  Ftotal = Ftotal + Fpart
  Etotal = Etotal + Epart
NEXT h
RETURN

*****
calculate: '      real index calculation
correct = F(1) + F(nd)
n(i) = no + upper + lower + ((1 / (2 * pi ^ 2)) * (correct + Ftotal - Etotal))
RETURN

```

```

*****
results: '          output results
FOR q = 1 TO nd
PRINT #2, USING "#####.####  ###.#####  #####.#####"; w(q); n(q); a(q)
NEXT q
RETURN

```

```

*****
forward: 'forward difference
derr = (a(i + 1) - a(i)) / (w(i + 1) - w(i))
F(j) = (derr) / (2 * w(i))
RETURN

```

```

*****
backward: 'backward difference
derr = (a(i) - a(i - 1)) / (w(i) - w(i - 1))
F(j) = (derr) / (2 * w(i))
RETURN

```

```

*****
central: 'central difference
derr = (a(i + 1) - a(i - 1)) / (w(i + 1) - w(i - 1))
F(j) = (derr) / (2 * w(i))
RETURN

```

```

*****
exception:
derr = (a(i + 1) - a(i - 1)) / (w(i + 1) - w(i - 1))
E(j) = (derr) / (2 * w(i))
RETURN

```

Data Acquisition Program

This is the Data Acquisition program, which is written in Visual Basic. This program works with the National Instruments PCI E Series Data Acquisition Board and Software

```

Option Explicit
Dim i, j, NumSamps As Integer
Dim ScaledData As Variant
Dim directory, outfile As String

Private Sub cmdDown_Click()
txtdial.Text = Val(txtdial.Text) - 10
End Sub

Private Sub cmdDown2_Click()
txtdial.Text = Val(txtdial.Text) - 2
End Sub

Private Sub cmdUp_Click()
txtdial.Text = Val(txtdial.Text) + 10
End Sub

Private Sub cmdUp2_Click()
txtdial.Text = Val(txtdial.Text) + 2
End Sub

Private Sub Start_Click()
i = 0
NumSamps = 30

directory = txtDirectory.Text
outfile = directory & txtSubstance.Text & "\ " & txtGrating.Text & txtdial.Text & ".txt"
Open outfile For Output As #10
CWAI1.Device = DeviceNumEdit.Value
CWAI1.Channels(1).ChannelString = ChannelStringTextBox.Text
CWAI1.Configure
lblStatus.Caption = "Acquiring data..."
lblStatus.Refresh

CWAI1.Start

End Sub

Private Sub Stop_Click()
CWAI1.Stop
End Sub

Private Sub Quit_Click()
End
End Sub

Private Sub CWAI1_AcquiredData(ScaledData As Variant, BinaryCodes As Variant)
For j = 0 To NumSamps - 1
Print #10, Format(ScaledData(j), "#0.000")

```

```
Next j
MsgBox "Acquisition finished"

lblStatus.Caption = ""
lblStatus.Refresh

Close #10
End Sub

Private Sub CWAI1_DAGError(ByVal StatusCode As Long, ByVal ContextID As Long, ByVal
ContextDescription As String)
    MsgBox "Error: " & StatusCode & vbCrLf & "Context: " & ContextDescription & vbCrLf &
CWDAQTools1.GetErrorText(StatusCode)
End Sub

Private Sub CWAI1_DAGWarning(ByVal StatusCode As Long, ByVal ContextID As Long, ByVal
ContextDescription As String)
    MsgBox "Warning: " & StatusCode & vbCrLf & "Context: " & ContextDescription & vbCrLf &
CWDAQTools1.GetErrorText(StatusCode)
End Sub
```

Data Reduction Program

This program reduced the individual data files into time averaged values of wavelength and intensity (voltage in volts).

```

'           Michael R. Anderson
'           Data Reduction Program
'           November 1999

CLS
E$ = "C:\Anderson\Thesis\Data\water\empty05.txt"
OPEN E$ FOR OUTPUT AS #2
PRINT #2, "wavelength (nm)  voltage (Volts)"
J$ = "C:\Anderson\Thesis\Data\water\empty05\"
DIM a AS LONG
DIM b AS LONG
' a is the data file number first 4 digits are grating no,
' the last four is the wavelength dial number
' b is the value to subtract off of x IOT get the wavelength dial
' number from the file
DEFDBL C-Z

'           MAIN PROGRAM

FOR x = 1 TO 3
  IF x = 1 THEN
    GOSUB 1000: 'reduction for grating 7301
  ELSEIF x = 2 THEN
    GOSUB 2000: 'reduction for grating 7302
  ELSEIF x = 3 THEN
    GOSUB 3000: 'reduction for grating 7303
  END IF
NEXT x

CLOSE #2
END

*****
1000'
  a = 73013130: ' a is the start dial setting
  b = 73010000
  FOR z = 3130 TO 6470 STEP 10
    ' Z is the dial setting of the monochromater (indicates wavelength)
    vttotal = 0
    IF (z > 6470 AND z <= 6990) THEN GOTO 1050: 'this statement allows for non-consecutive data files
    C$ = LTRIM$(STR$(a)) + ".TXT"
    D$ = J$ + C$
    PRINT a
    OPEN D$ FOR INPUT AS #1
    WHILE NOT EOF(1)
      INPUT #1, v
      vttotal = vttotal + v
    WEND
    CLOSE #1
    'Calculate time averaged voltage reading
    ' Vavg is the time averaged voltage multiplied by the sensitivity factor from the lock-in amplifier
    ' lambda is the wavelength of the voltage.
    Vavg = vttotal / 30
  
```

```

        IF z < 2500 OR z > 6490 THEN
            Vavg = Vavg * .001
        ELSEIF (Z >= 3250 AND Z <= 3260) OR (Z >= 8000 AND Z <= 8000) THEN
            ' Vavg = Vavg * .003
        ELSEIF (Z >= 3270 AND Z <= 3310) OR (Z >= 8000 AND Z <= 8000) THEN
            ' Vavg = Vavg * .01
        ELSEIF Z >= 3320 AND Z <= 3350 THEN
            ' Vavg = Vavg * .03
        ELSEIF z >= 3130 AND z <= 3170 THEN
            Vavg = Vavg * .1
        ELSEIF (z >= 3180 AND z <= 3310) OR (z >= 5270 AND z <= 6470) OR (z >= 8000 AND z <= 8000) THEN
            Vavg = Vavg * .3
        ELSEIF (z >= 3320 AND z <= 5260) OR (z >= 8000 AND z <= 8000) THEN
            Vavg = Vavg * 1
        END IF

        lambda = (a - b) * .8
        PRINT #2, USING " #####.##      #####.#####"; lambda; Vavg
1050 '
        a = a + 10
        NEXT z
        RETURN

*****
2000'
        a = 73023240
        b = 73020000
        FOR y = 3240 TO 5630 STEP 10
            total = 0
            C$ = LTRIM$(STR$(a)) + ".TXT"
            D$=J$+C$
            OPEN D$ FOR INPUT AS #1
            WHILE NOT EOF(1)
                INPUT #1, v
                total = total + v
            WEND
            CLOSE #1
            avg = total / 30

            IF y < 3240 OR y > 5630 THEN
                avg = avg * .01
            ELSEIF (y >= 239 AND y <= 257) OR (y >= 8000 AND y <= 8000) THEN
                avg = avg * .03
            ELSEIF (y >= 3240 AND y <= 4760) OR (y >= 5200 AND y <= 5630) THEN
                avg = avg * 1
            ELSEIF (y >= 3240 AND y <= 3300) OR (y >= 7000 AND y <= 8000) THEN
                avg = avg * .3
            ELSEIF y >= 4770 AND y <= 5190 THEN
                avg = avg * 3
            END IF

            lambda = (a - b) * 1.6
            PRINT #2, USING " #####.##      #####.#####"; lambda; avg
            a = a + 10
            NEXT y
        RETURN

*****
3000'
        a = 73033760
        b = 73030000
        FOR z = 3760 TO 6250 STEP 10

```

```

vtotal = 0
C$ = LTRIM$(STR$(a)) + ".TXT"
D$ = J$ + C$
OPEN D$ FOR INPUT AS #1
WHILE NOT EOF(1)
  INPUT #1, v
  vtotal = vtotal + v
WEND
CLOSE #1
Vavg = vtotal / 30

IF z < 3140 OR z > 6250 THEN
  Vavg = Vavg * .01
ELSEIF (Z >= 8000 AND Z <= 8000) OR (Z >= 8000 AND Z <= 8000) THEN
  Vavg = Vavg * .03
ELSEIF (z >= 3760 AND z <= 3880) OR (z >= 5060 AND z <= 5670) THEN
  Vavg = Vavg * 1
ELSEIF (z >= 5680 AND z <= 6250) THEN
  Vavg = Vavg * .3
ELSEIF z >= 3890 AND z <= 5050 THEN
  Vavg = Vavg * 3
END IF

lambda = (a - b) * 2.4
PRINT #2, USING " #####.##      #####.#####"; lambda; Vavg
a = a + 10
NEXT z

```

RETURN

APPENDIX B.
OPERATING PROCEDURE

1. Turn on integrated infrared light source and power supply. Set current to 2.00 amps. When turning off light source, set current back to zero before switching off power to prevent a power surge that might damage the global the next time the light source is turned on.
2. In order to match the acceptance cone of the monochromator, the image of the global is focused onto the entrance slit of the monochromator. The distance between the exit flange of the light source and the entrance slit of the monochromator must be 3.2 inches.
3. Turn on optical chopper and set chopping frequency to any non-multiple of 60 Hz. A chopping frequency of 100 Hz was used in the experiment.
4. Slowly fill the infrared detector with liquid nitrogen using the funnel. This process may take several minutes as the liquid nitrogen cools the dewar to 77 K. If the signal pre-amplifier is needed, place the switch on the back of the detector to the up position.
5. Turn the lock-in amplifier on and set to the following:

Float/Ground switch	ground
track filter	on
line filter	on
time constant	0.1 sec, 6 db
x10 expand	on (if required)
sensitivity	adjusted to keep readout between 3 and 10

The time constant must match the sampling speed of the data acquisition program.

6. Place the empty sample cell into the cell holder and lock into place.
7. Set the phase on the lock-in amplifier to attain the maximum positive output. The maximum signal is generally reached by setting the monochromator to the blaze wavelength for the particular grating. Advance the reference phase 270° by pressing the $+90^\circ$ key three times. Adjust the phase arrow keys until the output display reads zero. Once zero is achieved, press the $+90^\circ$ once more. The signal and reference are exactly in phase at the input of the detector.
8. Scan background noise. Position the filter wheel to the stop position, blocking the light beam to the monochromator. In this experiment, ten samples were taken. A typical dial setting in the 9000s range was used for background measurements. Background measurements should be taken at the lowest signal multiplier as possible.
9. Set the filter wheel to the lowest cutoff filter. Filter cutoffs are listed in table B.1.

Table B.1 Long-Pass Filter Specifications

Wheel Position	cutoff wavelength (nm)	maximum transmittance (nm)
1	2500	5000
2	3500	7000
3	6000	12000
4	8500	15000
5	stop	n/a

10. Scan the empty cell over the wavelength range of the grating in the monochromator. Increment scan by one dial number. Ranges used in the experiment are listed in table B.2. Scan cell with luer lock plugs in place. While scanning, change long-pass filters as necessary to block higher order wavelengths.

Table B.2 Grating Specifications

Grating number	Blaze wavelength (μm)	Usable wavelength range (μm)	Range used in experiment (μm)	Monochromator dial range	Wavelength counter multiplier
77301	4	2.5-8.0	2.504-5.400	320-675	8
77302	7	4.5-16	5.408-14.000	338-875	16

11. Scan empty cell over grating ranges. Interchange gratings as required. Once scan is complete, scan background noise again by setting filter wheel to the stop position. Remove cell from holder and fill cell with sample fluid using syringe. Replace luer lock plugs and return cell to cell holder.

12. Scan background noise with filled cell. Scan filled cell over the same wavelength ranges as the empty cell. In regions of rapidly changing spectrum, the dial can be incremented five times as much. If this is done, either the empty cell must also be scanned at the same increment, or the empty cell data can be interpolated between data points. When scan is complete, scan background noise again.

13. Remove filled cell from cell holder. Evacuate cell using vacuum pump. Dry any remaining fluid with dry nitrogen. Disassemble cell and change teflon spacer. Clean any leftover residue from cell windows. Repeat process with new cell thickness.

14. Reduce raw data using data reduction computer program. Average the reduced background scan readings to use in calculation of transmittance. Transmittance, absorption coefficients and extinction coefficients are calculated using a spreadsheet. Blending the absorption coefficients into a continuous curve forms the absorption

coefficient curve. Selection of the absorption coefficient values is based on the protocol explained in Section 3.

15. Plot raw intensity values for both the filled and empty cells. These plots will show where adjustments may need to be made to correct for anomalies caused by atmospheric absorption, constructive and destructive interference, and Woods anomalies and ghosts in the grating.

16. Data files for the Kramers-Kronig program are produced from the spreadsheet data. Data must be in increasing frequency order. Additional data outside the experimental range is produced on the spreadsheet using the assumptions of the behavior of the extinction coefficient or the absorption coefficient.

APPENDIX C.
OPTICAL CONSTANTS

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
434.78	1.392	0.0011522	6.295	23.000	731.85	1.388	0.0002625	2.414	13.664
444.21	1.387	0.0013305	7.427	22.512	732.71	1.388	0.0002392	2.202	13.648
454.31	1.386	0.0016962	9.684	22.011	733.57	1.388	0.0003444	3.175	13.632
464.36	1.386	0.0012847	7.496	21.535	734.43	1.388	0.0003999	3.690	13.616
474.35	1.385	0.0007931	4.727	21.081	735.29	1.388	0.0003415	3.155	13.600
484.23	1.386	0.0006056	3.685	20.651	737.03	1.388	0.0004911	4.549	13.568
494.54	1.386	0.0005592	3.475	20.221	737.90	1.388	0.0007577	7.026	13.552
504.45	1.386	0.0004915	3.116	19.824	738.77	1.388	0.0008254	7.662	13.536
514.53	1.386	0.0004359	2.819	19.435	739.65	1.388	0.0010401	9.668	13.520
524.37	1.386	0.0003548	2.338	19.071	740.52	1.388	0.0014086	13.108	13.504
534.49	1.386	0.0002655	1.783	18.709	741.40	1.388	0.0014531	13.538	13.488
535.49	1.386	0.0002516	1.693	18.674	742.28	1.388	0.0019200	17.909	13.472
536.83	1.386	0.0002443	1.648	18.628	744.05	1.387	0.0018392	17.196	13.440
538.17	1.386	0.0002370	1.603	18.581	744.93	1.387	0.0016866	15.788	13.424
539.52	1.386	0.0002298	1.558	18.535	745.82	1.386	0.0013022	12.204	13.408
541.56	1.386	0.0002224	1.514	18.465	746.71	1.386	0.0011510	10.800	13.392
554.84	1.386	0.0002107	1.469	18.023	747.61	1.386	0.0008796	8.263	13.376
561.43	1.386	0.0002146	1.514	17.812	748.50	1.386	0.0007491	7.046	13.360
563.29	1.386	0.0002201	1.558	17.753	749.40	1.386	0.0005314	5.005	13.344
564.78	1.386	0.0002259	1.603	17.706	750.30	1.387	0.0004614	4.351	13.328
566.29	1.386	0.0002316	1.648	17.659	751.20	1.387	0.0003578	3.378	13.312
566.67	1.386	0.0002377	1.693	17.647	752.11	1.387	0.0003236	3.059	13.296
568.94	1.386	0.0002431	1.738	17.577	753.01	1.387	0.0002601	2.461	13.280
577.45	1.386	0.0002520	1.829	17.318	753.92	1.387	0.0002239	2.121	13.264
584.19	1.386	0.0002615	1.920	17.118	754.83	1.387	0.0001748	1.658	13.248
589.44	1.386	0.0002530	1.874	16.965	756.66	1.387	0.0001544	1.468	13.216
595.16	1.386	0.0002445	1.829	16.802	757.58	1.387	0.0001315	1.252	13.200
598.47	1.386	0.0002371	1.783	16.709	758.50	1.387	0.0001123	1.071	13.184
602.66	1.386	0.0002295	1.738	16.593	764.06	1.387	0.0001159	1.113	13.088
606.92	1.386	0.0002161	1.648	16.477	765.93	1.387	0.0001105	1.063	13.056
612.54	1.386	0.0002082	1.603	16.325	768.76	1.387	0.0001187	1.147	13.008
621.39	1.386	0.0002110	1.648	16.093	770.65	1.388	0.0001249	1.209	12.976
627.77	1.386	0.0002146	1.693	15.929	771.60	1.388	0.0001297	1.258	12.960
630.10	1.386	0.0002195	1.738	15.870	774.47	1.388	0.0001396	1.359	12.912
644.43	1.387	0.0002090	1.693	15.518	776.40	1.388	0.0001306	1.274	12.880
648.36	1.387	0.0002022	1.648	15.424	785.18	1.388	0.0001361	1.343	12.736
654.35	1.387	0.0001895	1.558	15.282	787.15	1.388	0.0001964	1.943	12.704
664.06	1.387	0.0001761	1.469	15.059	789.14	1.388	0.0002047	2.030	12.672
674.42	1.387	0.0001682	1.425	14.828	791.14	1.388	0.0002125	2.113	12.640
684.50	1.387	0.0001606	1.381	14.609	793.15	1.388	0.0002592	2.583	12.608
694.89	1.387	0.0001632	1.425	14.391	796.18	1.388	0.0002639	2.640	12.560
704.45	1.387	0.0001811	1.603	14.195	798.21	1.389	0.0002849	2.857	12.528
714.29	1.387	0.0001290	1.158	14.000	800.26	1.389	0.0003816	3.838	12.496
715.10	1.387	0.0001288	1.158	13.984	802.31	1.389	0.0004880	4.920	12.464
715.92	1.387	0.0001287	1.158	13.968	803.34	1.389	0.0004832	4.878	12.448
716.74	1.387	0.0001285	1.158	13.952	804.38	1.389	0.0005810	5.872	12.432
717.57	1.387	0.0001284	1.158	13.936	805.41	1.389	0.0007085	7.170	12.416
720.05	1.387	0.0001279	1.158	13.888	806.45	1.389	0.0007056	7.151	12.400
721.71	1.387	0.0001276	1.158	13.856	807.49	1.389	0.0008751	8.880	12.384
723.38	1.387	0.0001273	1.158	13.824	808.54	1.389	0.0009766	9.923	12.368
725.06	1.387	0.0001522	1.387	13.792	809.59	1.389	0.0011499	11.699	12.352
726.74	1.387	0.0001667	1.522	13.760	810.64	1.389	0.0012767	13.005	12.336
728.44	1.388	0.0002022	1.851	13.728	811.69	1.390	0.0013891	14.169	12.320
729.29	1.388	0.0001971	1.807	13.712	812.74	1.389	0.0016648	17.003	12.304
730.14	1.388	0.0002137	1.961	13.696	813.80	1.389	0.0017010	17.396	12.288
730.99	1.388	0.0002120	1.948	13.680	814.86	1.389	0.0019496	19.964	12.272

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
815.93	1.389	0.0021383	21.925	12.256	885.27	1.389	0.0008315	9.251	11.296
816.99	1.389	0.0021314	21.882	12.240	886.52	1.389	0.0009116	10.156	11.280
818.06	1.389	0.0025488	26.202	12.224	887.78	1.389	0.0009344	10.425	11.264
819.14	1.389	0.0027545	28.354	12.208	889.05	1.389	0.0009803	10.952	11.248
820.21	1.389	0.0025903	26.698	12.192	890.31	1.389	0.0010650	11.915	11.232
821.29	1.389	0.0029732	30.685	12.176	891.58	1.389	0.0010948	12.266	11.216
824.54	1.388	0.0029570	30.639	12.128	892.86	1.389	0.0012336	13.842	11.200
825.63	1.388	0.0032662	33.887	12.112	894.13	1.389	0.0013133	14.756	11.184
826.72	1.388	0.0032571	33.838	12.096	895.42	1.389	0.0013807	15.535	11.168
827.81	1.387	0.0028265	29.403	12.080	896.70	1.390	0.0015415	17.370	11.152
828.91	1.387	0.0026717	27.830	12.064	897.99	1.390	0.0016334	18.432	11.136
830.01	1.387	0.0025442	26.536	12.048	899.28	1.390	0.0017691	19.992	11.120
831.12	1.387	0.0022123	23.106	12.032	900.58	1.390	0.0017869	20.223	11.104
832.22	1.387	0.0021507	22.492	12.016	901.88	1.390	0.0019001	21.535	11.088
833.33	1.387	0.0017957	18.804	12.000	903.18	1.390	0.0019704	22.363	11.072
834.45	1.387	0.0017432	18.280	11.984	904.49	1.390	0.0019815	22.523	11.056
835.56	1.387	0.0014864	15.608	11.968	905.80	1.390	0.0021718	24.720	11.040
836.68	1.387	0.0014156	14.883	11.952	907.11	1.390	0.0022885	26.086	11.024
837.80	1.387	0.0012879	13.559	11.936	908.43	1.391	0.0024030	27.432	11.008
838.93	1.387	0.0012234	12.898	11.920	909.75	1.391	0.0028094	32.118	10.992
841.18	1.387	0.0010869	11.489	11.888	911.08	1.391	0.0030079	34.437	10.976
842.32	1.388	0.0010656	11.279	11.872	912.41	1.391	0.0034843	39.950	10.960
843.45	1.388	0.0010241	10.854	11.856	913.74	1.391	0.0039736	45.627	10.944
844.59	1.388	0.0010568	11.217	11.840	915.08	1.391	0.0042026	48.327	10.928
845.74	1.388	0.0010764	11.440	11.824	916.42	1.391	0.0059128	68.092	10.912
846.88	1.388	0.0011125	11.839	11.808	919.12	1.389	0.0059439	68.652	10.880
848.03	1.388	0.0011373	12.119	11.792	920.47	1.390	0.0057874	66.943	10.864
849.18	1.388	0.0012213	13.033	11.776	921.83	1.389	0.0072862	84.403	10.848
850.34	1.388	0.0012813	13.691	11.760	923.19	1.387	0.0078318	90.858	10.832
851.50	1.388	0.0014553	15.572	11.744	924.56	1.386	0.0061011	70.884	10.816
852.66	1.388	0.0014772	15.828	11.728	925.93	1.386	0.0056018	65.180	10.800
853.83	1.388	0.0017150	18.401	11.712	927.30	1.386	0.0058269	67.900	10.784
854.99	1.388	0.0017981	19.319	11.696	928.68	1.385	0.0050134	58.508	10.768
856.16	1.388	0.0019760	21.259	11.680	930.06	1.385	0.0036854	43.073	10.752
857.34	1.388	0.0021096	22.728	11.664	931.45	1.385	0.0035195	41.195	10.736
858.52	1.388	0.0021954	23.686	11.648	932.84	1.385	0.0030780	36.081	10.720
859.70	1.388	0.0023778	25.688	11.632	934.23	1.386	0.0027508	32.294	10.704
860.88	1.388	0.0022636	24.488	11.616	935.63	1.386	0.0026245	30.858	10.688
863.26	1.388	0.0021038	22.822	11.584	937.03	1.386	0.0023692	27.898	10.672
864.45	1.387	0.0020803	22.598	11.568	938.44	1.386	0.0022251	26.240	10.656
865.65	1.387	0.0018034	19.617	11.552	939.85	1.387	0.0021582	25.490	10.640
866.85	1.387	0.0017206	18.742	11.536	941.27	1.387	0.0020773	24.571	10.624
868.06	1.387	0.0015131	16.505	11.520	942.68	1.387	0.0019867	23.534	10.608
869.26	1.387	0.0013915	15.200	11.504	944.11	1.387	0.0020379	24.178	10.592
870.47	1.387	0.0013290	14.538	11.488	945.54	1.387	0.0019676	23.379	10.576
871.69	1.387	0.0011776	12.899	11.472	946.97	1.387	0.0019819	23.584	10.560
872.91	1.388	0.0011193	12.278	11.456	948.41	1.387	0.0020345	24.247	10.544
874.13	1.388	0.0010591	11.634	11.440	951.29	1.388	0.0020553	24.569	10.512
875.35	1.388	0.0009696	10.665	11.424	952.74	1.388	0.0020874	24.991	10.496
876.58	1.388	0.0009695	10.679	11.408	954.20	1.388	0.0020676	24.792	10.480
877.81	1.388	0.0008822	9.732	11.392	955.66	1.388	0.0021211	25.473	10.464
879.04	1.388	0.0008681	9.589	11.376	958.59	1.388	0.0021542	25.949	10.432
880.28	1.388	0.0008611	9.525	11.360	960.06	1.389	0.0021792	26.290	10.416
881.52	1.388	0.0008318	9.214	11.344	961.54	1.389	0.0023559	28.467	10.400
882.77	1.388	0.0008063	8.944	11.328	963.02	1.390	0.0025054	30.320	10.384
884.02	1.388	0.0008875	9.860	11.312	964.51	1.390	0.0031713	38.437	10.368

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
966.00	1.391	0.0029692	36.044	10.352	1081.32	1.389	0.0009187	12.483	9.248
967.49	1.392	0.0049645	60.357	10.336	1083.19	1.389	0.0010014	13.631	9.232
968.99	1.389	0.0091969	111.988	10.320	1085.07	1.390	0.0006734	9.182	9.216
970.50	1.386	0.0056818	69.294	10.304	1086.96	1.390	0.0011782	16.094	9.200
973.52	1.387	0.0050955	62.336	10.272	1088.85	1.390	0.0015517	21.231	9.184
978.09	1.386	0.0049505	60.847	10.224	1090.75	1.390	0.0018391	25.209	9.168
981.16	1.386	0.0048525	59.829	10.192	1092.66	1.390	0.0021383	29.360	9.152
982.70	1.386	0.0043654	53.908	10.176	1094.57	1.389	0.0020124	27.680	9.136
985.80	1.385	0.0042329	52.437	10.144	1098.42	1.389	0.0019212	26.518	9.104
988.92	1.385	0.0041771	51.909	10.112	1102.29	1.389	0.0018353	25.422	9.072
990.49	1.385	0.0040379	50.259	10.096	1104.24	1.389	0.0016596	23.028	9.056
992.06	1.384	0.0035305	44.014	10.080	1106.20	1.389	0.0015823	21.995	9.040
993.64	1.384	0.0030514	38.101	10.064	1108.16	1.389	0.0015428	21.485	9.024
995.22	1.384	0.0025668	32.101	10.048	1110.12	1.389	0.0015039	20.979	9.008
996.81	1.384	0.0019342	24.229	10.032	1112.10	1.389	0.0014924	20.857	8.992
1000.00	1.385	0.0013128	16.497	10.000	1114.08	1.389	0.0014196	19.875	8.976
1001.60	1.385	0.0011642	14.654	9.984	1116.07	1.390	0.0013825	19.390	8.960
1003.21	1.386	0.0011754	14.818	9.968	1118.07	1.390	0.0013118	18.432	8.944
1004.82	1.386	0.0012055	15.222	9.952	1120.07	1.390	0.0012592	17.723	8.928
1008.07	1.386	0.0013348	16.909	9.920	1122.08	1.390	0.0012072	17.023	8.912
1009.69	1.386	0.0013140	16.673	9.904	1124.10	1.390	0.0011887	16.791	8.896
1011.33	1.386	0.0014579	18.528	9.888	1126.13	1.390	0.0011378	16.102	8.880
1012.97	1.386	0.0015598	19.855	9.872	1128.16	1.390	0.0011197	15.874	8.864
1014.61	1.386	0.0015182	19.357	9.856	1130.20	1.391	0.0011177	15.874	8.848
1016.26	1.386	0.0016184	20.668	9.840	1132.25	1.391	0.0011317	16.102	8.832
1017.92	1.386	0.0014537	18.595	9.824	1134.30	1.391	0.0011296	16.102	8.816
1019.58	1.386	0.0012638	16.192	9.808	1136.36	1.391	0.0011597	16.560	8.800
1021.24	1.386	0.0012112	15.544	9.792	1138.43	1.392	0.0011899	17.023	8.784
1022.91	1.386	0.0009901	12.727	9.776	1140.51	1.392	0.0012530	17.958	8.768
1024.59	1.386	0.0010046	12.935	9.760	1142.60	1.392	0.0013169	18.909	8.752
1026.27	1.386	0.0008355	10.775	9.744	1144.69	1.392	0.0014328	20.610	8.736
1027.96	1.386	0.0008344	10.779	9.728	1146.79	1.393	0.0015517	22.361	8.720
1029.65	1.387	0.0007477	9.675	9.712	1148.90	1.393	0.0017103	24.692	8.704
1031.35	1.387	0.0007439	9.641	9.696	1151.01	1.394	0.0020705	29.948	8.688
1033.06	1.387	0.0007216	9.368	9.680	1153.14	1.395	0.0028644	41.507	8.672
1034.77	1.387	0.0006897	8.968	9.664	1155.27	1.395	0.0038947	56.541	8.656
1036.48	1.387	0.0007190	9.365	9.648	1157.41	1.395	0.0050028	72.763	8.640
1038.21	1.387	0.0006220	8.115	9.632	1159.56	1.396	0.0062372	90.886	8.624
1039.93	1.387	0.0006608	8.636	9.616	1161.71	1.395	0.0087332	127.492	8.608
1041.67	1.387	0.0005819	7.617	9.600	1163.87	1.393	0.0099976	146.222	8.592
1043.41	1.387	0.0005779	7.577	9.584	1166.05	1.389	0.0106307	155.771	8.576
1045.15	1.387	0.0005440	7.145	9.568	1168.22	1.387	0.0075152	110.326	8.560
1046.90	1.387	0.0005693	7.489	9.552	1170.41	1.387	0.0051742	76.101	8.544
1048.66	1.388	0.0004776	6.294	9.536	1172.61	1.388	0.0030829	45.428	8.528
1052.19	1.388	0.0004908	6.489	9.504	1174.81	1.389	0.0024431	36.067	8.512
1055.74	1.388	0.0005047	6.696	9.472	1177.02	1.391	0.0020914	30.933	8.496
1059.32	1.388	0.0005134	6.834	9.440	1179.25	1.392	0.0022727	33.678	8.480
1061.12	1.388	0.0005307	7.077	9.424	1181.47	1.393	0.0027237	40.439	8.464
1062.93	1.388	0.0005368	7.170	9.408	1183.71	1.394	0.0032518	48.370	8.448
1066.55	1.388	0.0005454	7.310	9.376	1185.96	1.394	0.0042108	62.754	8.432
1070.21	1.389	0.0005857	7.876	9.344	1188.21	1.395	0.0051260	76.539	8.416
1072.04	1.389	0.0006258	8.430	9.328	1190.48	1.396	0.0064376	96.306	8.400
1073.88	1.389	0.0006390	8.623	9.312	1192.75	1.396	0.0083357	124.940	8.384
1075.73	1.389	0.0007679	10.381	9.296	1195.03	1.395	0.0097492	146.406	8.368
1077.59	1.389	0.0007506	10.164	9.280	1197.32	1.394	0.0124237	186.926	8.352
1079.45	1.389	0.0008584	11.644	9.264	1199.62	1.392	0.0137352	207.057	8.336

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frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1201.92	1.389	0.0141383	213.542	8.320	1352.81	1.414	0.0200875	341.486	7.392
1204.24	1.385	0.0128873	195.023	8.304	1355.75	1.417	0.0291954	497.397	7.376
1206.56	1.383	0.0096383	146.137	8.288	1358.70	1.410	0.0432428	738.324	7.360
1208.90	1.383	0.0073015	110.920	8.272	1361.66	1.393	0.0493832	845.001	7.344
1211.24	1.384	0.0050504	76.872	8.256	1364.63	1.378	0.0397341	681.379	7.328
1213.59	1.385	0.0038137	58.161	8.240	1367.62	1.375	0.0260303	447.358	7.312
1215.95	1.387	0.0033830	51.692	8.224	1370.61	1.379	0.0184399	317.602	7.296
1218.32	1.388	0.0033087	50.656	8.208	1373.63	1.384	0.0165346	285.413	7.280
1220.70	1.388	0.0033485	51.365	8.192	1376.65	1.387	0.0172729	298.813	7.264
1223.09	1.389	0.0035758	54.960	8.176	1379.69	1.388	0.0188976	327.640	7.248
1225.49	1.389	0.0035514	54.691	8.160	1382.74	1.387	0.0220275	382.750	7.232
1227.90	1.390	0.0035957	55.483	8.144	1385.81	1.384	0.0229446	399.571	7.216
1232.74	1.391	0.0038241	59.239	8.112	1388.89	1.381	0.0217873	380.260	7.200
1235.18	1.392	0.0047362	73.514	8.096	1391.98	1.379	0.0177505	310.495	7.184
1237.62	1.393	0.0061209	95.194	8.080	1395.09	1.379	0.0139717	244.941	7.168
1240.08	1.393	0.0093023	144.960	8.064	1398.21	1.382	0.0114428	201.054	7.152
1242.55	1.391	0.0116690	182.204	8.048	1401.35	1.384	0.0114019	200.786	7.136
1245.02	1.387	0.0116115	181.666	8.032	1404.49	1.385	0.0107545	189.811	7.120
1247.51	1.385	0.0080832	126.718	8.016	1407.66	1.387	0.0109954	194.500	7.104
1250.00	1.385	0.0062615	98.355	8.000	1410.84	1.388	0.0111827	198.259	7.088
1252.51	1.385	0.0048361	76.119	7.984	1414.03	1.389	0.0110262	195.926	7.072
1255.02	1.386	0.0039754	62.697	7.968	1417.23	1.390	0.0121952	217.190	7.056
1257.55	1.386	0.0034809	55.007	7.952	1420.46	1.392	0.0123252	220.005	7.040
1260.08	1.387	0.0027844	44.090	7.936	1423.69	1.393	0.0142910	255.675	7.024
1262.63	1.388	0.0024584	39.006	7.920	1426.94	1.393	0.0145940	261.691	7.008
1265.18	1.388	0.0021702	34.504	7.904	1430.21	1.394	0.0160397	288.274	6.992
1267.75	1.389	0.0019817	31.570	7.888	1433.49	1.395	0.0171433	308.815	6.976
1270.33	1.390	0.0023084	36.851	7.872	1436.78	1.396	0.0186207	336.200	6.960
1272.91	1.391	0.0028792	46.055	7.856	1440.09	1.398	0.0209096	378.394	6.944
1275.51	1.391	0.0035029	56.146	7.840	1443.42	1.399	0.0238135	431.942	6.928
1278.12	1.391	0.0044257	71.083	7.824	1446.76	1.399	0.0266572	484.643	6.912
1280.74	1.391	0.0044449	71.537	7.808	1450.12	1.400	0.0309868	564.665	6.896
1283.37	1.390	0.0042850	69.106	7.792	1453.49	1.400	0.0361718	660.682	6.880
1286.01	1.390	0.0041367	66.851	7.776	1456.88	1.400	0.0429580	786.462	6.864
1288.66	1.390	0.0037029	59.964	7.760	1460.28	1.395	0.0545087	1000.257	6.848
1291.32	1.390	0.0034167	55.444	7.744	1463.70	1.382	0.0611223	1124.246	6.832
1294.00	1.390	0.0032569	52.961	7.728	1467.14	1.367	0.0609647	1123.983	6.816
1296.68	1.390	0.0026384	42.992	7.712	1470.59	1.354	0.0533017	985.014	6.800
1299.38	1.391	0.0021757	35.525	7.696	1474.06	1.347	0.0421735	781.204	6.784
1302.08	1.391	0.0016373	26.790	7.680	1477.54	1.344	0.0335260	622.488	6.768
1304.80	1.392	0.0010951	17.956	7.664	1481.04	1.343	0.0252988	470.843	6.752
1307.53	1.394	0.0009533	15.663	7.648	1484.56	1.344	0.0168350	314.066	6.736
1310.27	1.395	0.0010999	18.111	7.632	1488.10	1.346	0.0110647	206.910	6.720
1313.03	1.396	0.0017010	28.067	7.616	1491.65	1.351	0.0047741	89.489	6.704
1315.79	1.396	0.0022691	37.520	7.600	1495.22	1.356	0.0041391	77.771	6.688
1318.57	1.397	0.0025988	43.061	7.584	1498.80	1.359	0.0035484	66.832	6.672
1321.35	1.398	0.0031902	52.971	7.568	1502.40	1.361	0.0035110	66.286	6.656
1324.15	1.398	0.0035170	58.522	7.552	1506.02	1.362	0.0032314	61.155	6.640
1326.96	1.399	0.0037566	62.642	7.536	1509.66	1.363	0.0029121	55.246	6.624
1329.79	1.400	0.0039765	66.449	7.520	1513.32	1.364	0.0022076	41.981	6.608
1335.47	1.402	0.0042966	72.106	7.488	1516.99	1.366	0.0015070	28.728	6.592
1338.33	1.405	0.0047363	79.655	7.472	1520.68	1.367	0.0012691	24.252	6.576
1341.20	1.407	0.0062688	105.654	7.456	1524.39	1.368	0.0010701	20.499	6.560
1344.09	1.410	0.0092282	155.867	7.440	1528.12	1.369	0.0010868	20.870	6.544
1346.98	1.412	0.0127984	216.634	7.424	1531.86	1.370	0.0010568	20.343	6.528
1349.89	1.412	0.0176247	298.972	7.408	1535.63	1.370	0.0010269	19.816	6.512

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1539.41	1.371	0.0009971	19.289	6.496	1838.24	1.381	0.0003422	7.905	5.440
1543.21	1.371	0.0009675	18.762	6.480	1843.66	1.381	0.0003465	8.028	5.424
1547.03	1.372	0.0009380	18.235	6.464	1849.11	1.381	0.0003366	7.821	5.408
1550.87	1.372	0.0009086	17.707	6.448	1851.85	1.381	0.0003236	7.530	5.400
1554.73	1.373	0.0008794	17.180	6.432	1854.60	1.381	0.0003193	7.441	5.392
1558.60	1.373	0.0008503	16.653	6.416	1857.36	1.381	0.0002997	6.994	5.384
1562.50	1.373	0.0008213	16.126	6.400	1860.12	1.381	0.0002985	6.977	5.376
1566.42	1.374	0.0007925	15.599	6.384	1862.89	1.381	0.0002841	6.651	5.368
1570.35	1.374	0.0007638	15.072	6.368	1865.67	1.381	0.0002875	6.740	5.360
1574.31	1.374	0.0007352	14.545	6.352	1868.46	1.381	0.0002829	6.642	5.352
1578.28	1.375	0.0007068	14.017	6.336	1871.26	1.381	0.0002872	6.752	5.344
1582.28	1.375	0.0006785	13.490	6.320	1874.06	1.381	0.0002815	6.629	5.336
1586.29	1.375	0.0006503	12.963	6.304	1876.88	1.381	0.0002790	6.580	5.328
1590.33	1.375	0.0006176	12.342	6.288	1879.70	1.381	0.0002745	6.484	5.320
1598.47	1.376	0.0005967	11.986	6.256	1882.53	1.382	0.0002730	6.459	5.312
1606.68	1.376	0.0005746	11.600	6.224	1885.37	1.382	0.0002665	6.315	5.304
1614.99	1.377	0.0005597	11.359	6.192	1888.22	1.382	0.0002608	6.188	5.296
1623.38	1.377	0.0005680	11.587	6.160	1891.07	1.382	0.0002492	5.921	5.288
1627.60	1.377	0.0005862	11.990	6.144	1893.94	1.382	0.0002411	5.738	5.280
1631.85	1.378	0.0006235	12.786	6.128	1896.81	1.382	0.0002290	5.458	5.272
1636.13	1.378	0.0006328	13.010	6.112	1899.70	1.382	0.0002216	5.290	5.264
1640.42	1.378	0.0006865	14.151	6.096	1902.59	1.382	0.0002046	4.891	5.256
1644.74	1.378	0.0006971	14.408	6.080	1905.49	1.382	0.0001949	4.668	5.248
1649.08	1.378	0.0007290	15.108	6.064	1908.40	1.382	0.0001856	4.451	5.240
1653.44	1.378	0.0007891	16.396	6.048	1911.32	1.382	0.0001792	4.304	5.232
1657.83	1.378	0.0007877	16.410	6.032	1914.24	1.382	0.0001674	4.027	5.224
1666.67	1.379	0.0008144	17.057	6.000	1917.18	1.382	0.0001671	4.025	5.216
1675.60	1.379	0.0008185	17.233	5.968	1920.12	1.382	0.0001622	3.913	5.208
1680.11	1.379	0.0008289	17.500	5.952	1923.08	1.382	0.0001710	4.131	5.200
1689.19	1.379	0.0008248	17.508	5.920	1926.04	1.382	0.0001722	4.168	5.192
1693.77	1.379	0.0008249	17.558	5.904	1929.01	1.382	0.0001863	4.515	5.184
1703.00	1.379	0.0008363	17.897	5.872	1931.99	1.382	0.0001985	4.819	5.176
1707.65	1.379	0.0008008	17.183	5.856	1934.99	1.382	0.0002142	5.209	5.168
1712.33	1.379	0.0007675	16.515	5.840	1937.98	1.382	0.0002305	5.614	5.160
1721.76	1.379	0.0007047	15.246	5.808	1940.99	1.382	0.0002422	5.907	5.152
1726.52	1.379	0.0006404	13.894	5.792	1944.01	1.382	0.0002473	6.041	5.144
1731.30	1.379	0.0006172	13.428	5.776	1947.04	1.382	0.0002462	6.023	5.136
1736.11	1.379	0.0005471	11.936	5.760	1950.08	1.382	0.0002408	5.902	5.128
1740.95	1.380	0.0005115	11.191	5.744	1953.13	1.382	0.0002257	5.538	5.120
1745.81	1.380	0.0004691	10.291	5.728	1956.18	1.382	0.0002106	5.177	5.112
1750.70	1.380	0.0004435	9.758	5.712	1959.25	1.382	0.0001927	4.745	5.104
1755.62	1.380	0.0003911	8.629	5.696	1962.32	1.382	0.0001755	4.327	5.096
1760.56	1.380	0.0003794	8.394	5.680	1965.41	1.382	0.0001683	4.157	5.088
1770.54	1.380	0.0003258	7.250	5.648	1968.50	1.382	0.0001647	4.074	5.080
1775.57	1.380	0.0003105	6.928	5.632	1971.61	1.382	0.0001736	4.300	5.072
1780.63	1.380	0.0003210	7.184	5.616	1974.72	1.382	0.0001830	4.540	5.064
1785.71	1.380	0.0003301	7.407	5.600	1977.85	1.383	0.0001943	4.829	5.056
1790.83	1.380	0.0003494	7.863	5.584	1980.98	1.383	0.0002068	5.149	5.048
1795.98	1.381	0.0003600	8.124	5.568	1984.13	1.383	0.0002081	5.188	5.040
1801.15	1.381	0.0003327	7.530	5.552	1987.28	1.383	0.0002096	5.234	5.032
1806.36	1.381	0.0003156	7.163	5.536	1990.45	1.383	0.0001990	4.977	5.024
1811.59	1.381	0.0002920	6.647	5.520	1993.62	1.383	0.0001849	4.633	5.016
1816.86	1.381	0.0002787	6.362	5.504	1996.81	1.383	0.0001681	4.218	5.008
1822.16	1.381	0.0002917	6.679	5.488	2000.00	1.383	0.0001676	4.212	5.000
1827.49	1.381	0.0002974	6.831	5.472	2003.21	1.383	0.0001623	4.086	4.992
1832.85	1.381	0.0003437	7.915	5.456	2006.42	1.383	0.0001688	4.257	4.984

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2009.65	1.383	0.0001831	4.625	4.976	2208.48	1.385	0.0003016	8.371	4.528
2012.88	1.383	0.0001967	4.975	4.968	2212.39	1.385	0.0002823	7.848	4.520
2016.13	1.383	0.0002184	5.533	4.960	2216.31	1.385	0.0002619	7.294	4.512
2019.39	1.383	0.0002293	5.818	4.952	2220.25	1.385	0.0002426	6.769	4.504
2022.65	1.383	0.0002353	5.981	4.944	2224.20	1.385	0.0002315	6.471	4.496
2025.93	1.383	0.0002350	5.983	4.936	2228.16	1.385	0.0002200	6.159	4.488
2029.22	1.383	0.0002183	5.566	4.928	2232.14	1.385	0.0002249	6.310	4.480
2032.52	1.383	0.0001991	5.085	4.920	2236.14	1.385	0.0002306	6.479	4.472
2035.83	1.383	0.0001768	4.523	4.912	2240.14	1.385	0.0002475	6.967	4.464
2039.15	1.383	0.0001553	3.978	4.904	2244.17	1.385	0.0002694	7.596	4.456
2042.48	1.383	0.0001374	3.526	4.896	2248.20	1.385	0.0002890	8.164	4.448
2045.83	1.383	0.0001243	3.195	4.888	2252.25	1.385	0.0003212	9.090	4.440
2049.18	1.383	0.0001143	2.943	4.880	2256.32	1.385	0.0003486	9.883	4.432
2052.55	1.383	0.0001064	2.744	4.872	2260.40	1.385	0.0003814	10.834	4.424
2055.92	1.383	0.0001057	2.731	4.864	2264.49	1.385	0.0004119	11.721	4.416
2059.31	1.383	0.0001057	2.737	4.856	2268.60	1.385	0.0004482	12.778	4.408
2062.71	1.383	0.0001055	2.734	4.848	2272.73	1.385	0.0004808	13.732	4.400
2066.12	1.383	0.0001077	2.796	4.840	2276.87	1.385	0.0005080	14.534	4.392
2069.54	1.383	0.0001161	3.019	4.832	2281.02	1.385	0.0005153	14.769	4.384
2072.97	1.383	0.0001241	3.234	4.824	2285.19	1.385	0.0005111	14.678	4.376
2076.41	1.383	0.0001410	3.680	4.816	2289.38	1.385	0.0004843	13.932	4.368
2079.87	1.384	0.0001545	4.038	4.808	2293.58	1.385	0.0004540	13.086	4.360
2083.33	1.384	0.0001805	4.726	4.800	2297.79	1.385	0.0004159	12.009	4.352
2086.81	1.384	0.0002146	5.628	4.792	2302.03	1.385	0.0003785	10.951	4.344
2090.30	1.384	0.0002435	6.397	4.784	2306.27	1.385	0.0003455	10.013	4.336
2093.80	1.384	0.0002741	7.212	4.776	2310.54	1.386	0.0003212	9.327	4.328
2097.32	1.384	0.0002966	7.818	4.768	2314.82	1.386	0.0003109	9.042	4.320
2100.84	1.384	0.0003105	8.197	4.760	2319.11	1.386	0.0003003	8.751	4.312
2104.38	1.384	0.0003115	8.238	4.752	2323.42	1.386	0.0002967	8.662	4.304
2107.93	1.384	0.0002994	7.932	4.744	2327.75	1.386	0.0002923	8.549	4.296
2111.49	1.384	0.0002835	7.522	4.736	2332.09	1.386	0.0002956	8.662	4.288
2115.06	1.384	0.0002616	6.954	4.728	2336.45	1.386	0.0003056	8.971	4.280
2118.64	1.384	0.0002401	6.393	4.720	2340.82	1.386	0.0003144	9.248	4.272
2122.24	1.384	0.0002259	6.025	4.712	2345.22	1.386	0.0003300	9.725	4.264
2125.85	1.384	0.0002103	5.618	4.704	2349.62	1.386	0.0003539	10.451	4.256
2129.47	1.384	0.0002008	5.375	4.696	2354.05	1.386	0.0003950	11.686	4.248
2133.11	1.384	0.0001949	5.226	4.688	2358.49	1.386	0.0004344	12.874	4.240
2136.75	1.384	0.0001863	5.001	4.680	2362.95	1.386	0.0004781	14.197	4.232
2140.41	1.384	0.0001849	4.974	4.672	2367.42	1.386	0.0005080	15.113	4.224
2144.08	1.384	0.0001834	4.941	4.664	2371.92	1.386	0.0005334	15.898	4.216
2147.77	1.384	0.0001874	5.059	4.656	2376.43	1.386	0.0005535	16.529	4.208
2151.46	1.384	0.0001968	5.321	4.648	2380.95	1.387	0.0005647	16.897	4.200
2155.17	1.384	0.0002007	5.435	4.640	2385.50	1.387	0.0005713	17.125	4.192
2158.90	1.384	0.0002128	5.774	4.632	2390.06	1.387	0.0005715	17.165	4.184
2162.63	1.384	0.0002217	6.024	4.624	2394.64	1.387	0.0005721	17.216	4.176
2166.38	1.384	0.0002334	6.353	4.616	2399.23	1.387	0.0005548	16.728	4.168
2170.14	1.384	0.0002455	6.694	4.608	2403.85	1.387	0.0005280	15.950	4.160
2173.91	1.384	0.0002608	7.125	4.600	2408.48	1.387	0.0004889	14.796	4.152
2177.70	1.384	0.0002759	7.549	4.592	2413.13	1.387	0.0004480	13.586	4.144
2181.50	1.384	0.0002952	8.092	4.584	2417.80	1.387	0.0004082	12.402	4.136
2185.32	1.384	0.0003076	8.447	4.576	2422.48	1.387	0.0003806	11.586	4.128
2189.14	1.384	0.0003250	8.942	4.568	2427.18	1.387	0.0003611	11.014	4.120
2192.98	1.384	0.0003334	9.188	4.560	2431.91	1.387	0.0003576	10.928	4.112
2196.84	1.384	0.0003380	9.331	4.552	2436.65	1.387	0.0003635	11.131	4.104
2200.70	1.384	0.0003329	9.206	4.544	2441.41	1.387	0.0003812	11.695	4.096
2204.59	1.385	0.0003207	8.884	4.536	2446.18	1.388	0.0003993	12.273	4.088

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2450.98	1.388	0.0004198	12.931	4.080	2753.30	1.404	0.0026751	92.557	3.632
2455.80	1.388	0.0004328	13.357	4.072	2759.38	1.406	0.0024991	86.658	3.624
2460.63	1.388	0.0004413	13.646	4.064	2765.49	1.408	0.0026244	91.205	3.616
2465.48	1.388	0.0004427	13.715	4.056	2771.62	1.411	0.0026669	92.887	3.608
2470.36	1.388	0.0004341	13.475	4.048	2777.78	1.417	0.0027703	96.703	3.600
2475.25	1.388	0.0004246	13.206	4.040	2783.96	1.419	0.0148163	518.337	3.592
2480.16	1.388	0.0004038	12.585	4.032	2790.18	1.415	0.0152017	533.007	3.584
2485.09	1.388	0.0003876	12.105	4.024	2796.42	1.415	0.0156539	550.090	3.576
2490.04	1.388	0.0003661	11.456	4.016	2802.69	1.415	0.0166773	587.370	3.568
2495.01	1.388	0.0003471	10.881	4.008	2808.99	1.416	0.0179670	634.214	3.560
2500.00	1.389	0.0003298	10.360	4.000	2815.32	1.418	0.0198840	703.465	3.552
2505.01	1.389	0.0003180	10.010	3.992	2821.67	1.419	0.0221011	783.666	3.544
2510.04	1.389	0.0003093	9.756	3.984	2828.05	1.420	0.0250370	889.773	3.536
2515.09	1.389	0.0003133	9.901	3.976	2834.47	1.422	0.0283894	1011.203	3.528
2520.16	1.389	0.0003230	10.229	3.968	2840.91	1.423	0.0328769	1173.704	3.520
2525.25	1.389	0.0003450	10.947	3.960	2847.38	1.423	0.0377071	1349.207	3.512
2530.36	1.390	0.0003775	12.004	3.952	2853.88	1.422	0.0427346	1532.586	3.504
2535.50	1.390	0.0004359	13.888	3.944	2860.41	1.420	0.0475135	1707.871	3.496
2540.65	1.390	0.0004731	15.104	3.936	2866.97	1.418	0.0527348	1899.897	3.488
2545.83	1.390	0.0005339	17.082	3.928	2873.56	1.414	0.0593609	2143.536	3.480
2551.02	1.390	0.0006022	19.306	3.920	2880.18	1.407	0.0617022	2233.214	3.472
2556.24	1.390	0.0006833	21.951	3.912	2886.84	1.402	0.0615040	2231.186	3.464
2561.48	1.391	0.0007570	24.367	3.904	2893.52	1.398	0.0626709	2278.778	3.456
2566.74	1.391	0.0008396	27.080	3.896	2900.23	1.396	0.0633233	2307.841	3.448
2572.02	1.391	0.0009151	29.578	3.888	2906.98	1.393	0.0662100	2418.663	3.440
2577.32	1.391	0.0009606	31.112	3.880	2913.75	1.389	0.0688122	2519.577	3.432
2582.65	1.391	0.0010153	32.950	3.872	2920.56	1.384	0.0721545	2648.132	3.424
2587.99	1.391	0.0010408	33.849	3.864	2927.40	1.379	0.0752494	2768.184	3.416
2593.36	1.392	0.0010777	35.122	3.856	2934.27	1.369	0.0817937	3015.988	3.408
2598.75	1.392	0.0010970	35.824	3.848	2941.18	1.352	0.0819100	3027.391	3.400
2604.17	1.392	0.0011240	36.784	3.840	2948.11	1.336	0.0694509	2572.950	3.392
2609.60	1.392	0.0011534	37.824	3.832	2955.08	1.330	0.0555481	2062.758	3.384
2615.06	1.392	0.0011717	38.505	3.824	2962.09	1.329	0.0443424	1650.544	3.376
2620.55	1.393	0.0011956	39.373	3.816	2969.12	1.330	0.0360273	1344.217	3.368
2626.05	1.393	0.0011915	39.319	3.808	2976.19	1.331	0.0296522	1108.991	3.360
2631.58	1.393	0.0011901	39.355	3.800	2983.29	1.333	0.0241032	903.608	3.352
2637.13	1.393	0.0011908	39.462	3.792	2990.43	1.335	0.0196603	738.812	3.344
2642.71	1.394	0.0011802	39.193	3.784	2997.60	1.337	0.0166214	626.110	3.336
2648.31	1.394	0.0011920	39.670	3.776	3004.81	1.334	0.0146084	551.605	3.328
2653.93	1.394	0.0012206	40.709	3.768	3012.05	1.337	0.0019949	75.509	3.320
2659.57	1.395	0.0012581	42.046	3.760	3019.32	1.345	0.0016025	60.802	3.312
2665.25	1.395	0.0013488	45.175	3.752	3026.63	1.348	0.0013042	49.603	3.304
2670.94	1.396	0.0014445	48.482	3.744	3033.98	1.351	0.0010558	40.255	3.296
2676.66	1.396	0.0015925	53.565	3.736	3041.36	1.354	0.0008828	33.739	3.288
2682.40	1.396	0.0017331	58.418	3.728	3048.78	1.355	0.0007547	28.912	3.280
2688.17	1.397	0.0019060	64.384	3.720	3056.24	1.357	0.0006631	25.467	3.272
2693.97	1.397	0.0021615	73.173	3.712	3063.73	1.359	0.0005859	22.559	3.264
2699.78	1.398	0.0022280	75.589	3.704	3071.25	1.360	0.0005476	21.134	3.256
2705.63	1.398	0.0026494	90.080	3.696	3078.82	1.361	0.0005195	20.099	3.248
2711.50	1.399	0.0026201	89.277	3.688	3086.42	1.362	0.0004980	19.314	3.240
2717.39	1.399	0.0026630	90.935	3.680	3094.06	1.363	0.0004977	19.352	3.232
2723.31	1.400	0.0029110	99.620	3.672	3101.74	1.364	0.0005144	20.051	3.224
2729.26	1.400	0.0024920	85.469	3.664	3109.45	1.365	0.0005561	21.729	3.216
2735.23	1.401	0.0028534	98.078	3.656	3117.21	1.365	0.0005862	22.963	3.208
2741.23	1.402	0.0025387	87.451	3.648	3125.00	1.366	0.0006324	24.833	3.200
2747.25	1.403	0.0023848	82.332	3.640	3132.83	1.366	0.0006972	27.446	3.192

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3140.70	1.367	0.0007716	30.454	3.184	3654.97	1.377	0.0000987	4.532	2.736
3148.62	1.367	0.0008255	32.663	3.176	3665.69	1.377	0.0001107	5.097	2.728
3156.57	1.368	0.0008558	33.945	3.168	3676.47	1.377	0.0001236	5.708	2.720
3164.56	1.368	0.0008988	35.743	3.160	3687.32	1.377	0.0001390	6.443	2.712
3172.59	1.369	0.0009217	36.747	3.152	3698.23	1.377	0.0001513	7.030	2.704
3180.66	1.369	0.0009094	36.347	3.144	3709.20	1.377	0.0001691	7.883	2.696
3188.78	1.369	0.0008797	35.252	3.136	3720.24	1.377	0.0001888	8.828	2.688
3196.93	1.369	0.0008301	33.349	3.128	3731.34	1.377	0.0002112	9.904	2.680
3205.13	1.370	0.0007785	31.356	3.120	3742.52	1.377	0.0002355	11.076	2.672
3213.37	1.370	0.0006926	27.966	3.112	3753.75	1.377	0.0002800	13.208	2.664
3221.65	1.370	0.0005929	24.004	3.104	3765.06	1.377	0.0002880	13.624	2.656
3229.97	1.371	0.0008662	35.159	3.096	3776.44	1.377	0.0003091	14.670	2.648
3238.34	1.371	0.0007692	31.300	3.088	3787.88	1.377	0.0003286	15.644	2.640
3246.75	1.371	0.0006907	28.181	3.080	3799.39	1.378	0.0003418	16.317	2.632
3255.21	1.371	0.0006331	25.899	3.072	3810.98	1.378	0.0003543	16.969	2.624
3263.71	1.371	0.0005872	24.082	3.064	3822.63	1.378	0.0003623	17.403	2.616
3272.25	1.372	0.0005564	22.878	3.056	3834.36	1.378	0.0003655	17.610	2.608
3280.84	1.372	0.0005345	22.037	3.048	3846.15	1.378	0.0003710	17.932	2.600
3289.47	1.372	0.0005170	21.369	3.040	3858.03	1.378	0.0003756	18.208	2.592
3298.15	1.372	0.0005059	20.967	3.032	3869.97	1.378	0.0004050	19.698	2.584
3306.88	1.372	0.0004974	20.668	3.024	3881.99	1.378	0.0003392	16.549	2.576
3315.65	1.373	0.0004879	20.329	3.016	3894.08	1.378	0.0003768	18.440	2.568
3324.47	1.373	0.0004826	20.162	3.008	3906.25	1.378	0.0003675	18.040	2.560
3333.33	1.373	0.0004758	19.931	3.000	3891.40	1.378	0.0003028	14.807	2.570
3342.25	1.373	0.0004653	19.543	2.992	3900.23	1.378	0.0002924	14.333	2.564
3351.21	1.373	0.0004500	18.953	2.984	3909.09	1.378	0.0002734	13.432	2.558
3360.22	1.373	0.0004290	18.115	2.976	3918.00	1.378	0.0002598	12.793	2.552
3369.27	1.373	0.0004009	16.975	2.968	3926.94	1.378	0.0002510	12.386	2.547
3378.38	1.374	0.0003660	15.540	2.960	3935.93	1.378	0.0002444	12.090	2.541
3387.53	1.374	0.0003297	14.035	2.952	3944.95	1.378	0.0002519	12.486	2.535
3396.74	1.374	0.0002885	12.314	2.944	3954.02	1.378	0.0002554	12.689	2.529
3406.00	1.374	0.0002533	10.840	2.936	3963.13	1.378	0.0002569	12.793	2.523
3415.30	1.374	0.0002212	9.493	2.928	3972.29	1.378	0.0002584	12.897	2.517
3424.66	1.374	0.0001936	8.331	2.920	3981.48	1.378	0.0002599	13.003	2.512
3434.07	1.374	0.0001734	7.484	2.912	3990.72	1.378	0.0002678	13.432	2.506
3443.53	1.375	0.0001548	6.699	2.904	4000.00	1.378	0.0002828	14.217	2.500
3453.04	1.375	0.0001390	6.030	2.896	4009.22	1.378	0.0003061	15.423	2.494
3462.60	1.375	0.0001202	5.231	2.888	4018.48	1.378	0.0003575	18.054	2.489
3472.22	1.375	0.0001049	4.575	2.880	4027.78	1.378	0.0004026	20.376	2.483
3481.89	1.375	0.0000888	3.884	2.872	4037.12	1.378	0.0004775	24.225	2.477
3491.62	1.375	0.0000748	3.282	2.864	4046.51	1.378	0.0004856	24.691	2.471
3501.40	1.375	0.0000638	2.805	2.856	4055.94	1.378	0.0004891	24.930	2.466
3511.24	1.375	0.0000554	2.447	2.848	4065.42	1.378	0.0004927	25.173	2.460
3521.13	1.375	0.0000470	2.080	2.840	4074.94	1.378	0.0005013	25.672	2.454
3531.07	1.376	0.0000437	1.938	2.832	4084.51	1.379	0.0005155	26.458	2.448
3541.08	1.376	0.0000414	1.842	2.824	4094.12	1.379	0.0005249	27.007	2.443
3551.14	1.376	0.0000411	1.835	2.816	4103.77	1.379	0.0005405	27.875	2.437
3561.25	1.376	0.0000394	1.763	2.808	4113.48	1.379	0.0005572	28.801	2.431
3571.43	1.376	0.0000417	1.873	2.800	4123.22	1.379	0.0005957	30.866	2.425
3581.66	1.376	0.0000437	1.965	2.792	4133.02	1.379	0.0006167	32.027	2.420
3591.95	1.376	0.0000470	2.124	2.784	4142.86	1.379	0.0006482	33.746	2.414
3602.31	1.376	0.0000522	2.364	2.776	4152.75	1.379	0.0006556	34.212	2.408
3612.72	1.376	0.0000593	2.692	2.768	4162.68	1.379	0.0006451	33.746	2.402
3623.19	1.376	0.0000658	2.998	2.760	4172.66	1.379	0.0006267	32.860	2.397
3633.72	1.377	0.0000751	3.430	2.752	4182.69	1.379	0.0005944	31.242	2.391
3644.32	1.377	0.0000867	3.968	2.744	4192.77	1.379	0.0005789	30.499	2.385

ISO-OCTANE					ISO-OCTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
4202.90	1.379	0.0005775	30.499	2.379	4860.34	1.380	0.0000295	1.801	2.057
4213.08	1.379	0.0005974	31.629	2.374	4873.95	1.380	0.0000294	1.801	2.052
4223.30	1.379	0.0006192	32.860	2.368	4887.64	1.380	0.0000293	1.801	2.046
4233.58	1.379	0.0006259	33.296	2.362	4901.41	1.380	0.0000292	1.801	2.040
4243.90	1.379	0.0006415	34.212	2.356	4915.25	1.380	0.0000284	1.756	2.034
4254.28	1.379	0.0006490	34.694	2.351	4929.18	1.380	0.0000283	1.756	2.029
4264.71	1.379	0.0006567	35.194	2.345	4943.18	1.380	0.0000283	1.756	2.023
4275.18	1.379	0.0006748	36.251	2.339	4957.27	1.380	0.0000282	1.756	2.017
4285.71	1.379	0.0007057	38.007	2.333	4971.43	1.380	0.0000281	1.756	2.011
4296.30	1.379	0.0007413	40.021	2.328	4985.67	1.380	0.0000280	1.756	2.006
4306.93	1.379	0.0007677	41.548	2.322	5000.00	1.380	0.0000279	1.756	2.000
4317.62	1.379	0.0007975	43.268	2.316					
4328.36	1.378	0.0007228	39.316	2.310					
4339.15	1.378	0.0006363	34.694	2.305					
4350.00	1.378	0.0006259	34.212	2.299					
4360.90	1.378	0.0005996	32.860	2.293					
4371.86	1.378	0.0005687	31.242	2.287					
4382.87	1.378	0.0005410	29.795	2.282					
4393.94	1.378	0.0004841	26.730	2.276					
4405.06	1.378	0.0003714	20.558	2.270					
4416.24	1.378	0.0003146	17.457	2.264					
4427.48	1.378	0.0002434	13.541	2.259					
4438.78	1.379	0.0002275	12.689	2.253					
4450.13	1.379	0.0001660	9.281	2.247					
4461.54	1.379	0.0001504	8.434	2.241					
4473.01	1.379	0.0001097	6.168	2.236					
4484.54	1.379	0.0000779	4.390	2.230					
4496.12	1.379	0.0000624	3.527	2.224					
4507.77	1.379	0.0000586	3.320	2.218					
4519.48	1.379	0.0000567	3.218	2.213					
4531.25	1.379	0.0000556	3.167	2.207					
4543.08	1.379	0.0000546	3.116	2.201					
4554.97	1.379	0.0000535	3.065	2.195					
4566.93	1.379	0.0000500	2.870	2.190					
4578.95	1.379	0.0000482	2.774	2.184					
4591.03	1.379	0.0000472	2.726	2.178					
4603.18	1.379	0.0000447	2.583	2.172					
4615.39	1.379	0.0000437	2.536	2.167					
4627.66	1.379	0.0000412	2.395	2.161					
4640.00	1.379	0.0000403	2.348	2.155					
4652.41	1.379	0.0000394	2.302	2.149					
4664.88	1.379	0.0000377	2.209	2.144					
4677.42	1.379	0.0000368	2.163	2.138					
4690.03	1.379	0.0000352	2.072	2.132					
4702.70	1.379	0.0000351	2.072	2.126					
4715.45	1.379	0.0000350	2.072	2.121					
4728.26	1.379	0.0000341	2.026	2.115					
4741.14	1.379	0.0000340	2.026	2.109					
4754.10	1.379	0.0000332	1.981	2.103					
4767.12	1.379	0.0000331	1.981	2.098					
4780.22	1.379	0.0000322	1.936	2.092					
4793.39	1.379	0.0000314	1.890	2.086					
4806.63	1.379	0.0000313	1.890	2.080					
4819.95	1.379	0.0000305	1.845	2.075					
4833.33	1.379	0.0000304	1.845	2.069					
4846.80	1.380	0.0000303	1.845	2.063					

					ISO-PENTANE				
frequency	n	ISO-PENTANE k	alpha	wavelength	frequency	n	ISO-PENTANE k	alpha	wavelength
cm ⁻¹			cm ⁻¹	microns	cm ⁻¹			cm ⁻¹	microns
670.00	1.349	0.0001854	1.561	14.925	768.76	1.348	0.0038153	36.858	13.008
680.00	1.349	0.0001827	1.561	14.706	774.47	1.349	0.0040252	39.174	12.912
690.00	1.350	0.0001800	1.561	14.493	776.40	1.349	0.0043707	42.643	12.880
700.00	1.350	0.0001775	1.561	14.286	777.36	1.349	0.0043768	42.755	12.864
714.29	1.350	0.0001739	1.561	14.000	779.30	1.348	0.0048031	47.037	12.832
715.10	1.350	0.0001737	1.561	13.984	780.27	1.347	0.0048570	47.624	12.816
715.92	1.350	0.0001732	1.558	13.968	781.25	1.347	0.0036213	35.552	12.800
717.57	1.350	0.0001751	1.579	13.936	782.23	1.347	0.0035391	34.789	12.784
720.05	1.351	0.0002238	2.025	13.888	783.21	1.347	0.0032088	31.582	12.768
720.88	1.351	0.0002169	1.965	13.872	784.19	1.348	0.0029310	28.883	12.752
721.71	1.351	0.0002869	2.602	13.856	785.18	1.348	0.0028863	28.479	12.736
724.22	1.351	0.0003327	3.028	13.808	786.16	1.348	0.0031389	31.010	12.720
725.90	1.351	0.0003386	3.089	13.776	787.15	1.349	0.0032063	31.716	12.704
726.74	1.351	0.0003617	3.303	13.760	788.15	1.349	0.0036175	35.828	12.688
727.59	1.351	0.0003715	3.397	13.744	789.14	1.348	0.0038851	38.527	12.672
729.29	1.351	0.0004730	4.334	13.712	791.14	1.348	0.0039227	38.999	12.640
730.14	1.351	0.0004785	4.390	13.696	792.14	1.348	0.0041597	41.407	12.624
731.85	1.351	0.0005080	4.672	13.664	793.15	1.348	0.0042827	42.685	12.608
732.71	1.351	0.0006118	5.633	13.648	794.16	1.348	0.0052098	51.992	12.592
733.57	1.351	0.0006027	5.556	13.632	795.17	1.347	0.0049780	49.742	12.576
734.43	1.351	0.0006164	5.689	13.616	796.18	1.346	0.0042730	42.751	12.560
736.16	1.352	0.0006758	6.251	13.584	797.19	1.346	0.0040134	40.205	12.544
737.03	1.352	0.0007756	7.183	13.568	798.21	1.346	0.0035175	35.283	12.528
737.90	1.352	0.0007995	7.414	13.552	799.23	1.346	0.0028504	28.628	12.512
739.64	1.352	0.0008232	7.651	13.520	800.26	1.346	0.0025998	26.144	12.496
740.52	1.352	0.0009820	9.138	13.504	801.28	1.346	0.0023013	23.172	12.480
741.40	1.352	0.0011422	10.642	13.488	802.31	1.346	0.0021328	21.503	12.464
742.28	1.352	0.0012042	11.232	13.472	803.34	1.346	0.0018770	18.948	12.448
743.16	1.352	0.0012037	11.241	13.456	804.38	1.346	0.0017359	17.547	12.432
744.05	1.353	0.0012204	11.411	13.440	805.41	1.346	0.0014993	15.175	12.416
744.93	1.353	0.0014794	13.849	13.424	806.45	1.346	0.0011951	12.112	12.400
745.82	1.353	0.0017471	16.374	13.408	808.54	1.346	0.0011035	11.212	12.368
746.71	1.353	0.0018452	17.314	13.392	809.59	1.347	0.0009230	9.390	12.352
747.61	1.353	0.0019058	17.904	13.376	810.64	1.347	0.0008451	8.609	12.336
748.50	1.353	0.0022816	21.460	13.360	812.74	1.347	0.0007852	8.019	12.304
749.40	1.353	0.0027747	26.130	13.344	813.80	1.347	0.0007259	7.423	12.288
750.30	1.354	0.0028086	26.481	13.328	814.86	1.347	0.0006223	6.372	12.272
751.20	1.354	0.0034685	32.742	13.312	815.93	1.347	0.0005808	5.955	12.256
752.11	1.354	0.0041019	38.768	13.296	818.06	1.347	0.0004832	4.967	12.224
753.01	1.353	0.0046128	43.649	13.280	820.21	1.348	0.0004465	4.602	12.192
753.92	1.353	0.0045806	43.397	13.264	821.29	1.348	0.0004236	4.371	12.176
754.83	1.352	0.0047834	45.373	13.248	822.37	1.348	0.0003576	3.696	12.160
756.66	1.352	0.0049797	47.350	13.216	823.45	1.348	0.0003527	3.650	12.144
757.58	1.352	0.0051813	49.326	13.200	826.72	1.348	0.0003452	3.586	12.096
758.50	1.352	0.0053824	51.302	13.184	827.81	1.348	0.0003621	3.767	12.080
760.34	1.352	0.0055762	53.279	13.152	830.01	1.348	0.0003015	3.145	12.048
761.27	1.352	0.0060008	57.406	13.136	833.33	1.348	0.0002899	3.036	12.000
762.20	1.351	0.0080498	77.102	13.120	834.45	1.348	0.0002765	2.900	11.984
763.13	1.349	0.0068529	65.718	13.104	836.68	1.348	0.0002275	2.392	11.952
764.99	1.348	0.0068701	66.044	13.072	838.93	1.349	0.0002256	2.378	11.920
765.93	1.347	0.0055589	53.504	13.056	841.18	1.349	0.0001993	2.107	11.888
766.87	1.347	0.0040236	38.774	13.040	843.45	1.349	0.0001772	1.878	11.856
767.81	1.348	0.0037782	36.454	13.024	844.59	1.349	0.0001703	1.807	11.840
					848.03	1.349	0.0001880	2.004	11.792
					849.18	1.349	0.0002048	2.185	11.776

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
851.50	1.349	0.0002064	2.208	11.744	938.44	1.351	0.0015378	18.135	10.656
854.99	1.349	0.0002230	2.396	11.696	939.85	1.352	0.0015591	18.413	10.640
859.70	1.349	0.0002288	2.472	11.632	941.27	1.352	0.0016273	19.249	10.624
863.26	1.350	0.0002264	2.456	11.584	942.68	1.352	0.0017253	20.438	10.608
866.85	1.350	0.0002755	3.001	11.536	944.11	1.352	0.0017663	20.956	10.592
869.26	1.350	0.0002929	3.199	11.504	945.54	1.352	0.0018577	22.073	10.576
870.47	1.350	0.0003304	3.614	11.488	946.97	1.352	0.0020222	24.064	10.560
871.69	1.350	0.0003365	3.686	11.472	948.41	1.353	0.0022704	27.059	10.544
872.91	1.350	0.0003697	4.055	11.456	949.85	1.352	0.0024957	29.789	10.528
874.13	1.350	0.0003858	4.238	11.440	952.74	1.353	0.0014491	17.350	10.496
876.58	1.350	0.0004014	4.421	11.408	954.20	1.354	0.0017487	20.969	10.480
877.81	1.350	0.0004095	4.517	11.392	955.66	1.354	0.0020980	25.195	10.464
879.04	1.350	0.0004490	4.960	11.376	957.12	1.355	0.0025413	30.566	10.448
880.28	1.351	0.0005051	5.588	11.360	958.59	1.355	0.0030045	36.192	10.432
881.52	1.351	0.0005327	5.901	11.344	960.06	1.356	0.0030162	36.389	10.416
882.77	1.351	0.0005598	6.210	11.328	961.54	1.357	0.0040921	49.445	10.400
884.02	1.351	0.0006084	6.759	11.312	963.02	1.358	0.0056277	68.105	10.384
885.27	1.351	0.0006780	7.543	11.296	964.51	1.358	0.0072554	87.938	10.368
886.52	1.351	0.0007753	8.637	11.280	966.00	1.358	0.0103682	125.861	10.352
887.78	1.351	0.0008785	9.801	11.264	967.49	1.356	0.0125615	152.720	10.336
889.05	1.351	0.0009525	10.642	11.248	968.99	1.353	0.0150190	182.882	10.320
890.31	1.351	0.0010513	11.762	11.232	970.50	1.351	0.0134699	164.274	10.304
892.86	1.351	0.0011377	12.764	11.200	972.01	1.349	0.0142772	174.391	10.288
894.13	1.351	0.0010918	12.267	11.184	973.52	1.346	0.0135095	165.270	10.272
895.42	1.351	0.0011888	13.377	11.168	975.04	1.344	0.0104393	127.910	10.256
897.99	1.351	0.0012166	13.729	11.136	976.56	1.344	0.0081941	100.556	10.240
899.28	1.351	0.0012557	14.190	11.120	978.09	1.344	0.0070515	86.670	10.224
900.58	1.352	0.0013625	15.420	11.104	979.62	1.344	0.0059061	72.706	10.208
901.88	1.352	0.0016086	18.231	11.088	981.16	1.344	0.0043693	53.872	10.192
903.18	1.352	0.0019731	22.394	11.072	982.70	1.345	0.0030347	37.475	10.176
904.49	1.352	0.0023377	26.570	11.056	984.25	1.345	0.0026577	32.871	10.160
905.80	1.352	0.0026839	30.550	11.040	985.80	1.346	0.0019251	23.849	10.144
907.11	1.352	0.0029516	33.645	11.024	987.36	1.347	0.0011243	13.950	10.128
908.43	1.351	0.0031226	35.646	11.008	988.92	1.348	0.0013395	16.647	10.112
909.75	1.351	0.0031691	36.229	10.992	990.49	1.349	0.0016241	20.215	10.096
911.08	1.351	0.0032143	36.800	10.976	992.06	1.350	0.0017526	21.849	10.080
912.41	1.350	0.0031773	36.430	10.960	993.64	1.351	0.0026909	33.600	10.064
913.74	1.350	0.0030549	35.077	10.944	995.22	1.351	0.0029283	36.623	10.048
915.08	1.350	0.0029026	33.378	10.928	996.81	1.352	0.0039540	49.529	10.032
916.42	1.350	0.0027284	31.420	10.912	998.40	1.352	0.0047296	59.339	10.016
917.77	1.350	0.0025241	29.111	10.896	1000.00	1.352	0.0050940	64.014	10.000
919.12	1.350	0.0022604	26.108	10.880	1001.60	1.352	0.0061826	77.817	9.984
920.47	1.350	0.0020073	23.219	10.864	1003.21	1.351	0.0072063	90.848	9.968
921.83	1.350	0.0019144	22.177	10.848	1004.82	1.350	0.0078189	98.729	9.952
923.19	1.350	0.0017847	20.704	10.832	1006.44	1.350	0.0080554	101.879	9.936
924.56	1.350	0.0016558	19.238	10.816	1008.06	1.349	0.0094010	119.088	9.920
925.93	1.350	0.0015617	18.171	10.800	1009.69	1.348	0.0090917	115.357	9.904
927.30	1.350	0.0014512	16.911	10.784	1011.33	1.347	0.0087892	111.700	9.888
928.68	1.350	0.0012738	14.865	10.768	1012.97	1.345	0.0086071	109.562	9.872
930.06	1.351	0.0010738	12.550	10.752	1014.61	1.344	0.0072733	92.734	9.856
931.45	1.351	0.0017672	20.685	10.736	1016.26	1.344	0.0056447	72.087	9.840
932.84	1.351	0.0016535	19.383	10.720	1017.92	1.344	0.0051242	65.547	9.824
934.23	1.351	0.0015788	18.535	10.704	1019.58	1.344	0.0046812	59.977	9.808
935.63	1.351	0.0015347	18.044	10.688	1021.24	1.345	0.0035327	45.337	9.792
937.03	1.351	0.0015248	17.955	10.672	1022.91	1.345	0.0035137	45.167	9.776

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1024.59	1.346	0.0034801	44.808	9.760	1140.51	1.351	0.0071571	102.576	8.768
1026.27	1.346	0.0033040	42.610	9.744	1142.60	1.349	0.0081212	116.606	8.752
1027.96	1.346	0.0037070	47.886	9.728	1144.69	1.347	0.0070826	101.881	8.736
1029.65	1.346	0.0037950	49.103	9.712	1146.79	1.346	0.0053875	77.640	8.720
1031.35	1.346	0.0038659	50.103	9.696	1148.90	1.346	0.0037619	54.312	8.704
1033.06	1.345	0.0037679	48.914	9.680	1151.01	1.347	0.0024287	35.128	8.688
1034.77	1.345	0.0036060	46.890	9.664	1153.14	1.348	0.0016698	24.197	8.672
1036.48	1.345	0.0028410	37.003	9.648	1155.27	1.349	0.0017016	24.704	8.656
1038.21	1.345	0.0023287	30.382	9.632	1157.41	1.349	0.0016531	24.043	8.640
1039.93	1.345	0.0017819	23.286	9.616	1159.55	1.350	0.0019280	28.094	8.624
1043.41	1.346	0.0016126	21.145	9.584	1161.71	1.351	0.0024775	36.168	8.608
1045.15	1.346	0.0013747	18.055	9.568	1163.87	1.351	0.0034439	50.369	8.592
1046.90	1.346	0.0012119	15.943	9.552	1166.04	1.351	0.0041961	61.485	8.576
1048.66	1.346	0.0010565	13.923	9.536	1168.22	1.350	0.0049950	73.329	8.560
1050.42	1.346	0.0009852	13.004	9.520	1170.41	1.350	0.0055560	81.716	8.544
1052.19	1.347	0.0008987	11.882	9.504	1172.61	1.348	0.0056193	82.803	8.528
1053.96	1.347	0.0008374	11.091	9.488	1174.81	1.347	0.0049170	72.590	8.512
1055.74	1.347	0.0007619	10.108	9.472	1177.02	1.347	0.0037335	55.221	8.496
1057.53	1.347	0.0007360	9.781	9.456	1179.25	1.347	0.0027813	41.216	8.480
1059.32	1.347	0.0006714	8.937	9.440	1181.47	1.348	0.0022866	33.948	8.464
1061.12	1.347	0.0006469	8.627	9.424	1188.21	1.348	0.0020866	31.156	8.416
1062.93	1.348	0.0005809	7.760	9.408	1190.48	1.348	0.0018960	28.364	8.400
1064.74	1.348	0.0005594	7.484	9.392	1192.75	1.348	0.0017061	25.572	8.384
1068.38	1.348	0.0005087	6.829	9.360	1195.03	1.349	0.0015012	22.544	8.368
1072.04	1.348	0.0004950	6.668	9.328	1197.32	1.349	0.0013474	20.273	8.352
1073.88	1.348	0.0004645	6.269	9.312	1199.62	1.349	0.0012473	18.803	8.336
1077.59	1.349	0.0005886	7.971	9.280	1201.92	1.349	0.0011894	17.965	8.320
1079.45	1.349	0.0006051	8.208	9.264	1204.24	1.350	0.0011808	17.869	8.304
1081.31	1.349	0.0005384	7.316	9.248	1213.59	1.350	0.0011084	16.904	8.240
1085.07	1.349	0.0004248	5.792	9.216	1215.95	1.350	0.0010855	16.587	8.224
1086.96	1.349	0.0004454	6.084	9.200	1218.32	1.351	0.0010838	16.592	8.208
1088.85	1.349	0.0004451	6.090	9.184	1220.70	1.351	0.0011296	17.327	8.192
1090.75	1.349	0.0004934	6.763	9.168	1223.09	1.351	0.0011884	18.265	8.176
1092.66	1.350	0.0005025	6.900	9.152	1225.49	1.351	0.0012565	19.350	8.160
1094.57	1.350	0.0005086	6.996	9.136	1227.90	1.351	0.0013131	20.262	8.144
1098.42	1.350	0.0005233	7.223	9.104	1230.31	1.351	0.0013432	20.767	8.128
1100.35	1.350	0.0005697	7.878	9.088	1232.74	1.351	0.0013648	21.142	8.112
1102.29	1.350	0.0006205	8.595	9.072	1237.62	1.352	0.0014211	22.101	8.080
1104.24	1.351	0.0006612	9.174	9.056	1240.08	1.352	0.0014939	23.280	8.064
1106.19	1.351	0.0007379	10.257	9.040	1242.54	1.352	0.0015955	24.912	8.048
1108.16	1.351	0.0007874	10.965	9.024	1245.02	1.352	0.0017060	26.691	8.032
1110.12	1.351	0.0008719	12.164	9.008	1247.50	1.352	0.0018210	28.547	8.016
1112.10	1.351	0.0009179	12.828	8.992	1250.00	1.352	0.0019028	29.889	8.000
1114.08	1.352	0.0012253	17.155	8.976	1252.51	1.352	0.0021043	33.121	7.984
1116.07	1.352	0.0014116	19.798	8.960	1257.55	1.353	0.0022207	35.093	7.952
1118.07	1.352	0.0016314	22.922	8.944	1260.08	1.353	0.0023607	37.380	7.936
1120.07	1.352	0.0019331	27.209	8.928	1262.63	1.352	0.0022760	36.112	7.920
1122.08	1.353	0.0022408	31.597	8.912	1265.18	1.352	0.0022169	35.247	7.904
1124.10	1.353	0.0029705	41.961	8.896	1267.75	1.352	0.0018742	29.858	7.888
1126.13	1.353	0.0033230	47.026	8.880	1270.33	1.353	0.0016431	26.229	7.872
1128.16	1.353	0.0038857	55.088	8.864	1272.91	1.353	0.0016230	25.961	7.856
1130.20	1.353	0.0044479	63.172	8.848	1275.51	1.354	0.0018297	29.327	7.840
1132.25	1.352	0.0050081	71.256	8.832	1278.12	1.354	0.0020776	33.369	7.824
1136.36	1.352	0.0052493	74.959	8.800	1280.74	1.354	0.0021876	35.208	7.808
1138.43	1.352	0.0063795	91.265	8.784	1283.37	1.354	0.0022089	35.623	7.792

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1286.01	1.355	0.0021943	35.461	7.776	1450.12	1.371	0.0487822	888.946	6.896
1288.66	1.355	0.0027188	44.028	7.760	1453.49	1.361	0.0648412	1184.330	6.880
1291.32	1.355	0.0034972	56.750	7.744	1456.88	1.345	0.0672714	1231.585	6.864
1294.00	1.354	0.0037020	60.198	7.728	1460.28	1.330	0.0666977	1223.931	6.848
1296.68	1.354	0.0034767	56.651	7.712	1463.70	1.317	0.0577349	1061.941	6.832
1299.38	1.354	0.0029597	48.328	7.696	1467.14	1.309	0.0477826	880.949	6.816
1302.08	1.354	0.0025445	41.635	7.680	1470.59	1.305	0.0359925	665.140	6.800
1304.80	1.354	0.0023160	37.974	7.664	1474.06	1.307	0.0252824	468.321	6.784
1307.53	1.355	0.0019888	32.678	7.648	1477.54	1.311	0.0210066	390.035	6.768
1310.27	1.355	0.0016361	26.939	7.632	1481.04	1.314	0.0168755	314.075	6.752
1313.03	1.356	0.0015110	24.931	7.616	1484.56	1.316	0.0161724	301.705	6.736
1315.79	1.356	0.0011877	19.637	7.600	1488.10	1.317	0.0140369	262.490	6.720
1318.57	1.357	0.0011985	19.859	7.584	1491.65	1.318	0.0130080	243.831	6.704
1321.35	1.358	0.0013848	22.994	7.568	1495.22	1.318	0.0119166	223.906	6.688
1324.15	1.359	0.0019042	31.686	7.552	1498.80	1.316	0.0092482	174.184	6.672
1326.96	1.360	0.0026334	43.911	7.536	1502.40	1.318	0.0027905	52.683	6.656
1329.79	1.361	0.0035933	60.046	7.520	1506.02	1.323	0.0025914	49.042	6.640
1332.62	1.361	0.0045905	76.873	7.504	1509.66	1.325	0.0020933	39.712	6.624
1335.47	1.361	0.0051926	87.143	7.488	1513.32	1.326	0.0018333	34.864	6.608
1338.33	1.361	0.0053932	90.702	7.472	1535.63	1.332	0.0017244	33.277	6.512
1341.20	1.361	0.0055146	92.943	7.456	1539.41	1.332	0.0016381	31.690	6.496
1344.09	1.362	0.0055180	93.200	7.440	1543.21	1.333	0.0015523	30.102	6.480
1346.98	1.363	0.0058997	99.862	7.424	1547.03	1.333	0.0014741	28.658	6.464
1349.89	1.364	0.0060870	103.255	7.408	1550.87	1.334	0.0014277	27.825	6.448
1352.81	1.366	0.0068942	117.200	7.392	1554.73	1.334	0.0014050	27.450	6.432
1355.75	1.369	0.0073980	126.039	7.376	1558.60	1.335	0.0013522	26.484	6.416
1358.70	1.371	0.0125793	214.778	7.360	1562.50	1.335	0.0013303	26.121	6.400
1361.66	1.371	0.0165997	284.040	7.344	1566.42	1.335	0.0011847	23.320	6.384
1364.63	1.369	0.0206859	354.731	7.328	1570.35	1.336	0.0011031	21.768	6.368
1367.61	1.366	0.0217464	373.732	7.312	1574.31	1.336	0.0010266	20.310	6.352
1370.61	1.366	0.0241517	415.979	7.296	1578.28	1.336	0.0009768	19.374	6.336
1373.63	1.363	0.0281268	485.511	7.280	1582.28	1.337	0.0009178	18.250	6.320
1376.65	1.357	0.0303024	524.216	7.264	1586.29	1.337	0.0008551	17.045	6.304
1379.69	1.351	0.0285845	495.589	7.248	1590.33	1.337	0.0008127	16.241	6.288
1382.74	1.347	0.0244700	425.192	7.232	1594.39	1.337	0.0008022	16.072	6.272
1385.81	1.346	0.0194035	337.905	7.216	1598.47	1.338	0.0008106	16.283	6.256
1388.89	1.347	0.0166159	290.002	7.200	1602.56	1.338	0.0008075	16.262	6.240
1391.98	1.349	0.0148756	260.206	7.184	1606.68	1.338	0.0007959	16.069	6.224
1395.09	1.350	0.0136343	239.026	7.168	1610.82	1.338	0.0007937	16.067	6.208
1398.21	1.352	0.0129628	227.762	7.152	1614.99	1.339	0.0008018	16.273	6.192
1401.35	1.354	0.0128067	225.524	7.136	1619.17	1.339	0.0008220	16.726	6.176
1404.49	1.355	0.0141731	250.146	7.120	1623.38	1.339	0.0008145	16.617	6.160
1407.66	1.355	0.0138390	244.801	7.104	1627.60	1.339	0.0008598	17.586	6.144
1410.84	1.356	0.0149845	265.662	7.088	1631.85	1.339	0.0009015	18.486	6.128
1414.03	1.357	0.0158037	280.819	7.072	1636.13	1.339	0.0009166	18.846	6.112
1417.23	1.357	0.0164005	292.083	7.056	1640.42	1.340	0.0009645	19.882	6.096
1420.45	1.358	0.0167459	298.913	7.040	1644.74	1.340	0.0010178	21.037	6.080
1423.69	1.359	0.0184897	330.792	7.024	1653.44	1.340	0.0011158	23.183	6.048
1426.94	1.359	0.0189324	339.485	7.008	1662.23	1.340	0.0010841	22.644	6.016
1430.21	1.360	0.0200643	360.607	6.992	1666.67	1.340	0.0011062	23.169	6.000
1433.49	1.361	0.0199510	359.392	6.976	1671.12	1.340	0.0011269	23.666	5.984
1436.78	1.365	0.0219260	395.876	6.960	1675.60	1.340	0.0010603	22.325	5.968
1440.09	1.367	0.0263483	476.817	6.944	1680.11	1.340	0.0009707	20.494	5.952
1443.42	1.370	0.0297842	540.242	6.928	1689.19	1.340	0.0009162	19.448	5.920
1446.76	1.372	0.0393588	715.564	6.912	1693.77	1.340	0.0008950	19.049	5.904

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1698.37	1.340	0.0008622	18.400	5.888	1926.04	1.343	0.0002355	5.699	5.192
1703.00	1.341	0.0007804	16.701	5.872	1929.01	1.343	0.0002382	5.774	5.184
1707.65	1.341	0.0007402	15.885	5.856	1931.99	1.343	0.0002436	5.914	5.176
1712.33	1.341	0.0007087	15.250	5.840	1934.98	1.343	0.0002365	5.750	5.168
1717.03	1.341	0.0006544	14.119	5.824	1937.98	1.344	0.0002265	5.516	5.160
1726.52	1.341	0.0006198	13.448	5.792	1940.99	1.344	0.0002101	5.124	5.152
1731.30	1.341	0.0006076	13.219	5.776	1944.01	1.344	0.0001958	4.784	5.144
1736.11	1.341	0.0005769	12.586	5.760	1947.04	1.344	0.0001783	4.364	5.136
1740.95	1.341	0.0005674	12.414	5.744	1950.08	1.344	0.0001641	4.021	5.128
1745.81	1.341	0.0005283	11.591	5.728	1953.13	1.344	0.0001446	3.550	5.120
1750.70	1.341	0.0004857	10.686	5.712	1956.18	1.344	0.0001326	3.260	5.112
1755.62	1.341	0.0004801	10.591	5.696	1959.25	1.344	0.0001249	3.075	5.104
1760.56	1.341	0.0004215	9.326	5.680	1962.32	1.344	0.0001190	2.933	5.096
1765.54	1.342	0.0003942	8.746	5.664	1965.41	1.344	0.0001075	2.655	5.088
1770.54	1.342	0.0003488	7.761	5.648	1968.50	1.344	0.0001030	2.547	5.080
1775.57	1.342	0.0003307	7.378	5.632	1971.61	1.344	0.0000954	2.362	5.072
1780.63	1.342	0.0003370	7.540	5.616	1974.72	1.344	0.0000887	2.200	5.064
1790.83	1.342	0.0003319	7.470	5.584	1977.85	1.344	0.0000799	1.985	5.056
1795.98	1.342	0.0003216	7.259	5.568	1980.98	1.344	0.0000725	1.804	5.048
1801.15	1.342	0.0002818	6.378	5.552	1984.13	1.344	0.0000696	1.736	5.040
1806.36	1.342	0.0002838	6.443	5.536	1987.28	1.344	0.0000633	1.581	5.032
1811.59	1.342	0.0002835	6.454	5.520	1990.45	1.344	0.0000652	1.630	5.024
1816.86	1.342	0.0003164	7.223	5.504	1993.62	1.344	0.0000618	1.549	5.016
1822.16	1.342	0.0003382	7.743	5.488	1996.81	1.344	0.0000605	1.519	5.008
1827.49	1.342	0.0003507	8.054	5.472	2000.00	1.344	0.0000619	1.556	5.000
1832.84	1.342	0.0003426	7.891	5.456	2003.21	1.344	0.0000599	1.508	4.992
1838.24	1.343	0.0003131	7.233	5.440	2006.42	1.344	0.0000624	1.573	4.984
1843.66	1.343	0.0002773	6.424	5.424	2009.65	1.344	0.0000645	1.628	4.976
1849.11	1.343	0.0002517	5.850	5.408	2012.88	1.344	0.0000667	1.687	4.968
1851.85	1.343	0.0002361	5.495	5.400	2016.13	1.344	0.0000743	1.883	4.960
1854.60	1.343	0.0002198	5.124	5.392	2019.39	1.344	0.0000749	1.900	4.952
1857.36	1.343	0.0002100	4.902	5.384	2022.65	1.344	0.0000856	2.176	4.944
1860.12	1.343	0.0002086	4.876	5.376	2025.93	1.344	0.0000898	2.285	4.936
1862.89	1.343	0.0002012	4.711	5.368	2029.22	1.344	0.0000984	2.509	4.928
1865.67	1.343	0.0002064	4.838	5.360	2032.52	1.344	0.0001052	2.686	4.920
1868.46	1.343	0.0001999	4.695	5.352	2035.83	1.344	0.0001918	4.906	4.912
1871.26	1.343	0.0002013	4.734	5.344	2039.15	1.344	0.0001952	5.002	4.904
1874.06	1.343	0.0001933	4.552	5.336	2042.48	1.344	0.0001956	5.020	4.896
1876.88	1.343	0.0001880	4.433	5.328	2045.83	1.344	0.0001990	5.115	4.888
1879.70	1.343	0.0001768	4.177	5.320	2049.18	1.345	0.0001989	5.123	4.880
1882.53	1.343	0.0001686	3.987	5.312	2052.55	1.345	0.0002031	5.239	4.872
1885.37	1.343	0.0001598	3.786	5.304	2055.92	1.345	0.0002116	5.468	4.864
1888.22	1.343	0.0001530	3.631	5.296	2059.31	1.345	0.0002117	5.478	4.856
1891.07	1.343	0.0001446	3.437	5.288	2062.71	1.345	0.0002073	5.374	4.848
1893.94	1.343	0.0001468	3.494	5.280	2066.12	1.345	0.0001989	5.165	4.840
1896.81	1.343	0.0001409	3.359	5.272	2069.54	1.345	0.0001937	5.037	4.832
1899.70	1.343	0.0001472	3.513	5.264	2072.97	1.345	0.0001887	4.916	4.824
1902.59	1.343	0.0001516	3.625	5.256	2076.41	1.345	0.0001907	4.977	4.816
1905.49	1.343	0.0001570	3.759	5.248	2079.87	1.345	0.0001929	5.043	4.808
1908.40	1.343	0.0001666	3.996	5.240	2083.33	1.345	0.0001995	5.223	4.800
1911.31	1.343	0.0001696	4.073	5.232	2086.81	1.345	0.0002077	5.446	4.792
1914.24	1.343	0.0001854	4.460	5.224	2090.30	1.345	0.0002108	5.537	4.784
1917.18	1.343	0.0001972	4.752	5.216	2093.80	1.345	0.0002155	5.670	4.776
1920.12	1.343	0.0002072	4.998	5.208	2097.32	1.345	0.0002109	5.559	4.768
1923.08	1.343	0.0002217	5.357	5.200	2100.84	1.345	0.0002134	5.635	4.760

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2104.38	1.345	0.0002090	5.527	4.752	2319.11	1.346	0.0003699	10.779	4.312
2107.93	1.345	0.0002133	5.651	4.744	2323.42	1.346	0.0003608	10.534	4.304
2111.49	1.345	0.0002133	5.660	4.736	2327.75	1.346	0.0003591	10.503	4.296
2115.06	1.345	0.0002231	5.931	4.728	2332.09	1.346	0.0003580	10.492	4.288
2118.64	1.345	0.0002295	6.109	4.720	2336.45	1.347	0.0003635	10.674	4.280
2122.24	1.345	0.0002438	6.502	4.712	2340.82	1.347	0.0003792	11.156	4.272
2125.85	1.345	0.0002443	6.527	4.704	2345.22	1.347	0.0004014	11.829	4.264
2129.47	1.345	0.0002502	6.695	4.696	2349.62	1.347	0.0004316	12.744	4.256
2133.11	1.345	0.0002425	6.501	4.688	2354.05	1.347	0.0004688	13.869	4.248
2136.75	1.345	0.0002384	6.400	4.680	2358.49	1.347	0.0005053	14.976	4.240
2140.41	1.345	0.0002276	6.120	4.672	2362.95	1.347	0.0005233	15.539	4.232
2144.08	1.345	0.0002194	5.910	4.664	2367.42	1.347	0.0005436	16.173	4.224
2147.77	1.345	0.0002163	5.838	4.656	2371.92	1.347	0.0005506	16.411	4.216
2151.46	1.345	0.0002172	5.872	4.648	2376.43	1.347	0.0005494	16.407	4.208
2155.17	1.345	0.0002235	6.053	4.640	2380.95	1.347	0.0005459	16.333	4.200
2158.89	1.345	0.0002331	6.324	4.632	2385.50	1.347	0.0005429	16.274	4.192
2162.63	1.345	0.0002432	6.610	4.624	2390.06	1.347	0.0005442	16.346	4.184
2166.38	1.345	0.0002492	6.783	4.616	2394.64	1.347	0.0005445	16.386	4.176
2170.14	1.345	0.0002529	6.896	4.608	2399.23	1.347	0.0005442	16.407	4.168
2173.91	1.345	0.0002452	6.698	4.600	2403.85	1.347	0.0005417	16.364	4.160
2177.70	1.345	0.0002363	6.467	4.592	2408.48	1.347	0.0005348	16.185	4.152
2181.50	1.345	0.0002213	6.067	4.584	2413.13	1.347	0.0005166	15.667	4.144
2185.31	1.345	0.0002091	5.741	4.576	2417.79	1.347	0.0004983	15.139	4.136
2189.14	1.345	0.0002003	5.510	4.568	2422.48	1.347	0.0004677	14.237	4.128
2192.98	1.345	0.0001957	5.393	4.560	2427.18	1.347	0.0004470	13.634	4.120
2196.84	1.345	0.0001943	5.365	4.552	2431.91	1.347	0.0004270	13.049	4.112
2200.70	1.346	0.0002034	5.624	4.544	2436.65	1.347	0.0004138	12.670	4.104
2204.59	1.346	0.0002067	5.727	4.536	2441.41	1.347	0.0004013	12.312	4.096
2208.48	1.346	0.0002178	6.044	4.528	2446.18	1.347	0.0003985	12.251	4.088
2212.39	1.346	0.0002207	6.135	4.520	2450.98	1.347	0.0003960	12.198	4.080
2216.31	1.346	0.0002283	6.359	4.512	2455.80	1.347	0.0003936	12.147	4.072
2220.25	1.346	0.0002370	6.614	4.504	2460.63	1.348	0.0003920	12.122	4.064
2224.20	1.346	0.0002499	6.985	4.496	2465.48	1.348	0.0003844	11.911	4.056
2228.16	1.346	0.0002622	7.343	4.488	2470.36	1.348	0.0003812	11.832	4.048
2232.14	1.346	0.0003167	8.882	4.480	2475.25	1.348	0.0003761	11.699	4.040
2236.14	1.346	0.0003198	8.987	4.472	2480.16	1.348	0.0003737	11.647	4.032
2240.14	1.346	0.0003359	9.455	4.464	2485.09	1.348	0.0003732	11.653	4.024
2244.17	1.346	0.0003622	10.215	4.456	2490.04	1.348	0.0003743	11.711	4.016
2248.20	1.346	0.0003801	10.739	4.448	2495.01	1.348	0.0003762	11.794	4.008
2252.25	1.346	0.0004006	11.339	4.440	2500.00	1.348	0.0003715	11.671	4.000
2256.32	1.346	0.0004131	11.713	4.432	2505.01	1.348	0.0003678	11.579	3.992
2260.40	1.346	0.0004248	12.065	4.424	2510.04	1.348	0.0003581	11.296	3.984
2264.49	1.346	0.0004312	12.270	4.416	2515.09	1.348	0.0003486	11.016	3.976
2268.60	1.346	0.0004382	12.492	4.408	2520.16	1.349	0.0003423	10.842	3.968
2272.73	1.346	0.0004370	12.480	4.400	2525.25	1.349	0.0003369	10.691	3.960
2276.87	1.346	0.0004400	12.589	4.392	2530.36	1.349	0.0003434	10.919	3.952
2281.02	1.346	0.0004329	12.407	4.384	2535.50	1.349	0.0003580	11.405	3.944
2285.19	1.346	0.0004292	12.325	4.376	2540.65	1.349	0.0004378	13.979	3.936
2289.38	1.346	0.0004170	11.997	4.368	2545.82	1.349	0.0004389	14.042	3.928
2293.58	1.346	0.0004119	11.872	4.360	2551.02	1.349	0.0004967	15.922	3.920
2297.79	1.346	0.0004009	11.576	4.352	2556.24	1.350	0.0005767	18.526	3.912
2302.03	1.346	0.0003898	11.277	4.344	2561.48	1.350	0.0006857	22.072	3.904
2306.27	1.346	0.0003922	11.367	4.336	2566.74	1.350	0.0008105	26.143	3.896
2310.54	1.346	0.0003864	11.219	4.328	2572.02	1.350	0.0009828	31.764	3.888
2314.81	1.346	0.0003752	10.914	4.320	2577.32	1.350	0.0011405	36.937	3.880

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2582.64	1.350	0.0013373	43.401	3.872	2913.75	1.352	0.0507466	1858.100	3.432
2587.99	1.350	0.0015019	48.844	3.864	2920.56	1.348	0.0541749	1988.265	3.424
2593.36	1.350	0.0016129	52.564	3.856	2927.40	1.340	0.0590949	2173.912	3.416
2598.75	1.350	0.0016665	54.424	3.848	2934.27	1.328	0.0585057	2157.288	3.408
2604.17	1.350	0.0016745	54.799	3.840	2941.18	1.317	0.0526951	1947.607	3.400
2609.60	1.350	0.0016749	54.926	3.832	2948.11	1.310	0.0446614	1654.573	3.392
2615.06	1.350	0.0016442	54.032	3.824	2955.08	1.306	0.0347951	1292.103	3.384
2620.55	1.350	0.0016062	52.893	3.816	2962.09	1.304	0.0283754	1056.209	3.376
2626.05	1.350	0.0015419	50.882	3.808	2969.12	1.304	0.0182273	680.078	3.368
2631.58	1.350	0.0014858	49.136	3.800	2976.19	1.307	0.0131840	493.081	3.360
2637.13	1.350	0.0014081	46.663	3.792	2983.29	1.309	0.0078121	292.869	3.352
2642.71	1.351	0.0013679	45.427	3.784	2990.43	1.315	0.0041187	154.777	3.344
2648.31	1.351	0.0013258	44.123	3.776	3026.63	1.326	0.0027563	104.832	3.304
2653.93	1.351	0.0013221	44.094	3.768	3033.98	1.327	0.0021315	81.268	3.296
2659.57	1.351	0.0012979	43.376	3.760	3041.36	1.328	0.0020016	76.498	3.288
2665.25	1.352	0.0013203	44.222	3.752	3048.78	1.329	0.0017283	66.217	3.280
2670.94	1.352	0.0013353	44.817	3.744	3056.23	1.330	0.0016391	62.951	3.272
2676.66	1.352	0.0018440	62.025	3.736	3063.73	1.330	0.0014535	55.959	3.264
2682.40	1.352	0.0018776	63.289	3.728	3071.25	1.331	0.0013646	52.666	3.256
2688.17	1.352	0.0019659	66.411	3.720	3078.82	1.332	0.0012605	48.769	3.248
2693.97	1.352	0.0015981	54.100	3.712	3086.42	1.332	0.0012048	46.730	3.240
2699.78	1.353	0.0017586	59.662	3.704	3094.06	1.333	0.0011553	44.919	3.232
2705.63	1.353	0.0018869	64.156	3.696	3101.74	1.333	0.0011499	44.820	3.224
2711.50	1.353	0.0021514	73.305	3.688	3109.45	1.334	0.0011651	45.524	3.216
2717.39	1.354	0.0022529	76.931	3.680	3117.21	1.334	0.0011597	45.428	3.208
2723.31	1.354	0.0027216	93.137	3.672	3125.00	1.334	0.0012127	47.623	3.200
2729.26	1.354	0.0030778	105.558	3.664	3132.83	1.335	0.0012666	49.866	3.192
2735.23	1.354	0.0024234	83.297	3.656	3140.70	1.335	0.0013559	53.512	3.184
2741.23	1.354	0.0025460	87.702	3.648	3148.61	1.335	0.0014331	56.701	3.176
2747.25	1.354	0.0026848	92.686	3.640	3156.57	1.335	0.0014581	57.838	3.168
2753.30	1.355	0.0023723	82.080	3.632	3164.56	1.335	0.0014379	57.183	3.160
2759.38	1.355	0.0022517	78.078	3.624	3172.59	1.335	0.0013223	52.716	3.152
2765.49	1.355	0.0019820	68.878	3.616	3180.66	1.336	0.0011856	47.387	3.144
2771.62	1.356	0.0016136	56.201	3.608	3188.78	1.336	0.0010534	42.212	3.136
2777.78	1.357	0.0012051	42.065	3.600	3196.93	1.336	0.0009008	36.187	3.128
2783.96	1.358	0.0010196	35.669	3.592	3205.13	1.336	0.0007805	31.437	3.120
2790.18	1.359	0.0008669	30.396	3.584	3213.37	1.336	0.0006438	25.999	3.112
2796.42	1.361	0.0009628	33.834	3.576	3221.65	1.337	0.0005477	22.173	3.104
2802.69	1.363	0.0007176	25.274	3.568	3229.97	1.337	0.0004574	18.567	3.096
2808.99	1.366	0.0020489	72.323	3.560	3238.34	1.337	0.0003966	16.138	3.088
2815.32	1.368	0.0033530	118.624	3.552	3246.75	1.337	0.0003482	14.205	3.080
2821.67	1.369	0.0054967	194.904	3.544	3255.21	1.337	0.0003245	13.272	3.072
2828.05	1.373	0.0049932	177.449	3.536	3263.71	1.338	0.0003100	12.714	3.064
2834.47	1.377	0.0113445	404.078	3.528	3272.25	1.338	0.0003165	13.015	3.056
2840.91	1.377	0.0149584	534.013	3.520	3280.84	1.338	0.0003300	13.606	3.048
2847.38	1.379	0.0196433	702.860	3.512	3289.47	1.338	0.0003476	14.370	3.040
2853.88	1.379	0.0251503	901.964	3.504	3298.15	1.338	0.0003735	15.480	3.032
2860.41	1.377	0.0312897	1124.709	3.496	3306.88	1.338	0.0003851	16.002	3.024
2866.97	1.374	0.0347950	1253.575	3.488	3315.65	1.338	0.0003900	16.251	3.016
2873.56	1.370	0.0386221	1394.654	3.480	3324.47	1.339	0.0003774	15.768	3.008
2880.18	1.366	0.0408760	1479.442	3.472	3333.33	1.339	0.0003580	14.994	3.000
2886.84	1.363	0.0417963	1516.248	3.464	3342.25	1.339	0.0003312	13.911	2.992
2893.52	1.361	0.0434220	1578.870	3.456	3351.21	1.339	0.0003046	12.829	2.984
2900.23	1.358	0.0457753	1668.297	3.448	3360.22	1.339	0.0002815	11.885	2.976
2906.98	1.355	0.0481052	1757.293	3.440	3369.27	1.339	0.0002571	10.887	2.968

ISO-PENTANE					ISO-PENTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3378.38	1.339	0.0002401	10.194	2.960	4400.00	1.342	0.0005765	31.875	2.273
3387.53	1.339	0.0002199	9.363	2.952	4500.00	1.342	0.0004741	26.813	2.222
3396.74	1.339	0.0002013	8.594	2.944	4600.00	1.343	0.0003763	21.750	2.174
3405.99	1.339	0.0001827	7.819	2.936	4700.00	1.343	0.0002825	16.688	2.128
3415.30	1.339	0.0001559	6.693	2.928	4800.00	1.343	0.0001927	11.625	2.083
3424.66	1.340	0.0001332	5.733	2.920	4900.00	1.343	0.0001066	6.563	2.041
3434.07	1.340	0.0001139	4.916	2.912	5000.00	1.343	0.0000239	1.500	2.000
3443.53	1.340	0.0000972	4.208	2.904					
3453.04	1.340	0.0000826	3.584	2.896					
3462.60	1.340	0.0000714	3.106	2.888					
3472.22	1.340	0.0000621	2.709	2.880					
3481.89	1.340	0.0000576	2.518	2.872					
3491.62	1.340	0.0000529	2.321	2.864					
3501.40	1.340	0.0000493	2.171	2.856					
3511.24	1.340	0.0000461	2.033	2.848					
3521.13	1.340	0.0000433	1.918	2.840					
3531.07	1.340	0.0000442	1.960	2.832					
3541.08	1.341	0.0000451	2.006	2.824					
3551.14	1.341	0.0000481	2.145	2.816					
3561.25	1.341	0.0000534	2.390	2.808					
3571.43	1.341	0.0000602	2.700	2.800					
3581.66	1.341	0.0000685	3.083	2.792					
3591.95	1.341	0.0000805	3.633	2.784					
3602.31	1.341	0.0000919	4.158	2.776					
3612.72	1.341	0.0001047	4.753	2.768					
3623.19	1.341	0.0001143	5.203	2.760					
3633.72	1.341	0.0001262	5.761	2.752					
3644.31	1.341	0.0001353	6.198	2.744					
3654.97	1.341	0.0001413	6.489	2.736					
3665.69	1.341	0.0001432	6.597	2.728					
3676.47	1.341	0.0001451	6.702	2.720					
3687.32	1.341	0.0001459	6.759	2.712					
3698.22	1.341	0.0001455	6.763	2.704					
3709.20	1.341	0.0001507	7.026	2.696					
3720.24	1.341	0.0001586	7.413	2.688					
3731.34	1.342	0.0001695	7.947	2.680					
3742.51	1.342	0.0001833	8.622	2.672					
3753.75	1.342	0.0002008	9.472	2.664					
3765.06	1.342	0.0002163	10.233	2.656					
3776.44	1.342	0.0002289	10.863	2.648					
3787.88	1.342	0.0002441	11.621	2.640					
3799.39	1.342	0.0002585	12.342	2.632					
3810.98	1.342	0.0002744	13.141	2.624					
3822.63	1.342	0.0002838	13.633	2.616					
3834.36	1.342	0.0002913	14.037	2.608					
3846.15	1.342	0.0003019	14.591	2.600					
3858.02	1.342	0.0003075	14.909	2.592					
3869.97	1.342	0.0003093	15.039	2.584					
3881.99	1.342	0.0003044	14.852	2.576					
3894.08	1.342	0.0003050	14.923	2.568					
3906.25	1.342	0.0002952	14.492	2.560					
4000.00	1.342	0.0004630	23.271	2.500					
4100.00	1.342	0.0006334	32.636	2.439					
4200.00	1.342	0.0007958	42.000	2.381					
4300.00	1.342	0.0006836	36.938	2.326					

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
670.00	1.371	0.0007126	6.000	14.925	756.66	1.366	0.0076931	73.150	13.216
680.00	1.372	0.0007022	6.000	14.706	757.58	1.365	0.0070329	66.953	13.200
690.00	1.373	0.0011533	10.000	14.493	758.50	1.364	0.0070021	66.741	13.184
700.00	1.375	0.0023305	20.500	14.286	759.42	1.363	0.0068870	65.723	13.168
714.29	1.380	0.0040457	36.314	14.000	760.34	1.363	0.0056756	54.229	13.152
715.10	1.383	0.0051678	46.439	13.984	761.27	1.363	0.0050429	48.243	13.136
715.92	1.385	0.0069373	62.412	13.968	762.20	1.363	0.0046418	44.460	13.120
716.74	1.385	0.0095303	85.838	13.952	763.13	1.363	0.0041088	39.402	13.104
717.57	1.383	0.0103911	93.699	13.936	764.06	1.363	0.0036516	35.061	13.088
718.39	1.383	0.0101288	91.438	13.920	764.99	1.363	0.0025907	24.904	13.072
719.22	1.385	0.0134065	121.168	13.904	765.93	1.364	0.0027136	26.118	13.056
720.05	1.384	0.0168102	152.106	13.888	766.87	1.364	0.0026748	25.776	13.040
720.88	1.380	0.0192303	174.204	13.872	767.81	1.364	0.0019994	19.291	13.024
721.71	1.378	0.0186418	169.068	13.856	768.76	1.365	0.0021807	21.067	13.008
722.54	1.377	0.0188995	171.602	13.840	769.70	1.365	0.0021656	20.947	12.992
723.38	1.377	0.0210875	191.691	13.824	770.65	1.365	0.0020255	19.616	12.976
724.22	1.371	0.0255147	232.205	13.808	771.60	1.365	0.0020648	20.021	12.960
725.06	1.366	0.0200442	182.630	13.792	772.56	1.365	0.0018019	17.494	12.944
725.90	1.366	0.0173396	158.171	13.776	773.51	1.365	0.0015705	15.265	12.928
726.74	1.366	0.0169864	155.128	13.760	774.47	1.365	0.0014595	14.205	12.912
727.59	1.365	0.0173735	158.849	13.744	775.43	1.366	0.0013510	13.165	12.896
728.44	1.363	0.0161395	147.739	13.728	776.40	1.366	0.0012102	11.808	12.880
729.29	1.362	0.0144454	132.385	13.712	778.33	1.367	0.0013131	12.843	12.848
730.14	1.362	0.0126799	116.341	13.696	779.30	1.367	0.0015848	15.520	12.832
730.99	1.362	0.0109354	100.452	13.680	780.27	1.367	0.0018312	17.955	12.816
731.85	1.363	0.0102047	93.849	13.664	781.25	1.367	0.0019230	18.879	12.800
732.71	1.363	0.0097131	89.434	13.648	782.23	1.368	0.0023959	23.551	12.784
733.57	1.364	0.0097831	90.184	13.632	783.21	1.367	0.0027909	27.469	12.768
734.43	1.363	0.0095639	88.266	13.616	784.19	1.367	0.0027431	27.032	12.752
735.29	1.363	0.0089173	82.395	13.600	785.18	1.367	0.0030944	30.532	12.736
736.16	1.363	0.0081929	75.791	13.584	786.16	1.367	0.0031287	30.909	12.720
737.03	1.364	0.0078911	73.085	13.568	787.15	1.367	0.0030563	30.232	12.704
737.90	1.364	0.0083167	77.119	13.552	788.15	1.367	0.0031687	31.383	12.688
738.77	1.363	0.0079365	73.679	13.536	789.14	1.366	0.0030878	30.621	12.672
739.64	1.363	0.0076360	70.974	13.520	790.14	1.366	0.0028933	28.729	12.656
740.52	1.363	0.0071484	66.521	13.504	791.14	1.366	0.0027924	27.762	12.640
741.40	1.363	0.0068166	63.508	13.488	793.15	1.366	0.0023611	23.533	12.608
742.28	1.363	0.0068925	64.291	13.472	795.17	1.366	0.0022515	22.498	12.576
743.16	1.363	0.0064617	60.344	13.456	796.18	1.366	0.0016647	16.655	12.560
744.05	1.363	0.0055064	51.485	13.440	797.19	1.367	0.0014238	14.263	12.544
744.93	1.363	0.0049075	45.939	13.424	799.23	1.367	0.0016191	16.261	12.512
745.82	1.364	0.0047787	44.788	13.408	800.26	1.368	0.0016088	16.178	12.496
746.71	1.364	0.0046718	43.837	13.392	801.28	1.368	0.0023786	23.950	12.480
747.61	1.364	0.0040817	38.347	13.376	802.31	1.367	0.0023734	23.928	12.464
748.50	1.364	0.0031359	29.496	13.360	803.34	1.368	0.0025246	25.486	12.448
749.40	1.365	0.0030484	28.708	13.344	804.38	1.367	0.0028183	28.487	12.432
750.30	1.366	0.0033359	31.452	13.328	805.41	1.367	0.0029167	29.520	12.416
751.20	1.367	0.0034919	32.963	13.312	806.45	1.367	0.0028766	29.152	12.400
752.11	1.367	0.0040299	38.088	13.296	807.49	1.367	0.0029293	29.724	12.384
753.01	1.367	0.0049484	46.825	13.280	808.54	1.367	0.0029690	30.166	12.368
753.92	1.367	0.0054091	51.246	13.264	809.59	1.366	0.0027274	27.748	12.352
754.83	1.367	0.0059565	56.500	13.248	810.64	1.366	0.0025629	26.107	12.336
755.74	1.367	0.0067754	64.346	13.232	811.69	1.366	0.0024698	25.192	12.320
					812.74	1.367	0.0022278	22.753	12.304
					821.29	1.367	0.0023078	23.818	12.176
					822.37	1.367	0.0022807	23.569	12.160

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
823.45	1.366	0.0023167	23.972	12.144	889.05	1.366	0.0049182	54.947	11.248
824.54	1.366	0.0021466	22.242	12.128	890.31	1.366	0.0043730	48.925	11.232
825.63	1.366	0.0018775	19.479	12.112	891.58	1.366	0.0040652	45.546	11.216
826.72	1.366	0.0017624	18.310	12.096	892.86	1.366	0.0034967	39.233	11.200
827.81	1.366	0.0015977	16.620	12.080	894.13	1.366	0.0031589	35.493	11.184
828.91	1.366	0.0014274	14.868	12.064	895.42	1.366	0.0030740	34.589	11.168
830.01	1.366	0.0012494	13.031	12.048	896.70	1.366	0.0028822	32.478	11.152
831.12	1.367	0.0012032	12.566	12.032	897.99	1.367	0.0028753	32.446	11.136
832.22	1.367	0.0011030	11.536	12.016	899.28	1.367	0.0030335	34.281	11.120
833.33	1.367	0.0009871	10.337	12.000	900.58	1.367	0.0030937	35.011	11.104
834.45	1.367	0.0009148	9.593	11.984	901.88	1.367	0.0032260	36.561	11.088
835.56	1.367	0.0008947	9.394	11.968	903.18	1.367	0.0034222	38.841	11.072
836.68	1.367	0.0008605	9.047	11.952	904.49	1.367	0.0034330	39.020	11.056
837.80	1.367	0.0007968	8.389	11.936	905.80	1.366	0.0034312	39.056	11.040
838.93	1.367	0.0007537	7.945	11.920	907.11	1.366	0.0034584	39.422	11.024
840.05	1.367	0.0007662	8.088	11.904	908.43	1.366	0.0032859	37.511	11.008
841.18	1.368	0.0007452	7.877	11.888	909.75	1.366	0.0031321	35.807	10.992
842.32	1.368	0.0007019	7.430	11.872	911.08	1.365	0.0028881	33.066	10.976
843.45	1.368	0.0006932	7.347	11.856	912.41	1.365	0.0025516	29.255	10.960
844.59	1.368	0.0007053	7.486	11.840	913.74	1.365	0.0022842	26.228	10.944
845.74	1.368	0.0006962	7.399	11.824	915.08	1.365	0.0017747	20.408	10.928
846.88	1.368	0.0007068	7.522	11.808	916.42	1.365	0.0014247	16.407	10.912
848.03	1.368	0.0007337	7.818	11.792	917.77	1.366	0.0013152	15.168	10.896
849.18	1.368	0.0007552	8.058	11.776	919.12	1.366	0.0011977	13.833	10.880
850.34	1.369	0.0007609	8.131	11.760	920.47	1.366	0.0010488	12.131	10.864
851.50	1.369	0.0007898	8.451	11.744	921.83	1.366	0.0009719	11.259	10.848
852.66	1.369	0.0008552	9.163	11.728	923.19	1.366	0.0009063	10.514	10.832
853.83	1.369	0.0009421	10.108	11.712	924.56	1.366	0.0008266	9.604	10.816
854.99	1.369	0.0010007	10.751	11.696	925.93	1.366	0.0007498	8.725	10.800
856.16	1.370	0.0010730	11.544	11.680	927.30	1.367	0.0007211	8.402	10.784
857.34	1.370	0.0017743	19.116	11.664	928.68	1.367	0.0006831	7.972	10.768
858.52	1.370	0.0020141	21.729	11.648	930.06	1.367	0.0006448	7.536	10.752
859.70	1.370	0.0022646	24.465	11.632	931.45	1.367	0.0006261	7.329	10.736
860.88	1.369	0.0025459	27.542	11.616	932.84	1.367	0.0006153	7.213	10.720
862.07	1.369	0.0025600	27.733	11.600	934.23	1.367	0.0006017	7.064	10.704
863.26	1.369	0.0024734	26.831	11.584	935.63	1.367	0.0005845	6.872	10.688
864.45	1.369	0.0025973	28.215	11.568	937.03	1.367	0.0005767	6.791	10.672
865.65	1.369	0.0024978	27.171	11.552	938.44	1.367	0.0005790	6.828	10.656
866.85	1.369	0.0022431	24.435	11.536	939.85	1.368	0.0005910	6.980	10.640
868.06	1.369	0.0022989	25.077	11.520	941.27	1.368	0.0006097	7.212	10.624
869.26	1.369	0.0022289	24.348	11.504	942.68	1.368	0.0006312	7.477	10.608
870.47	1.369	0.0020981	22.950	11.488	944.11	1.368	0.0006541	7.761	10.592
871.69	1.369	0.0021551	23.607	11.472	945.54	1.368	0.0006933	8.238	10.576
872.91	1.370	0.0022690	24.890	11.456	946.97	1.368	0.0007382	8.785	10.560
874.13	1.370	0.0023707	26.042	11.440	948.41	1.368	0.0007437	8.863	10.544
875.35	1.370	0.0027806	30.586	11.424	949.85	1.368	0.0007516	8.971	10.528
876.58	1.370	0.0032289	35.568	11.408	951.29	1.368	0.0007649	9.144	10.512
877.81	1.371	0.0036174	39.903	11.392	952.74	1.368	0.0007974	9.547	10.496
879.04	1.371	0.0043088	47.596	11.376	954.20	1.368	0.0007998	9.591	10.480
880.28	1.370	0.0051966	57.485	11.360	955.66	1.368	0.0007868	9.449	10.464
881.52	1.370	0.0054971	60.894	11.344	957.12	1.368	0.0008212	9.877	10.448
882.77	1.369	0.0058795	65.223	11.328	958.59	1.368	0.0008647	10.417	10.432
884.02	1.368	0.0062300	69.209	11.312	960.06	1.369	0.0008973	10.825	10.416
885.27	1.368	0.0059963	66.706	11.296	961.54	1.369	0.0010464	12.644	10.400
886.52	1.367	0.0057025	63.528	11.280	963.02	1.369	0.0010959	13.262	10.384
887.78	1.366	0.0055194	61.575	11.264	964.51	1.369	0.0012031	14.582	10.368

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
966.00	1.369	0.0014881	18.064	10.352	1059.32	1.369	0.0045063	59.987	9.440
967.49	1.369	0.0015742	19.139	10.336	1061.12	1.368	0.0047116	62.827	9.424
968.99	1.369	0.0016398	19.967	10.320	1062.93	1.367	0.0047470	63.406	9.408
970.50	1.368	0.0018357	22.387	10.304	1064.74	1.366	0.0040113	53.671	9.392
972.01	1.368	0.0016732	20.438	10.288	1066.55	1.366	0.0031508	42.229	9.376
973.52	1.368	0.0013822	16.910	10.272	1068.38	1.366	0.0019167	25.734	9.360
975.04	1.368	0.0013722	16.814	10.256	1072.04	1.367	0.0016578	22.333	9.328
976.56	1.368	0.0012791	15.697	10.240	1073.88	1.367	0.0013732	18.531	9.312
978.09	1.368	0.0010936	13.441	10.224	1075.73	1.367	0.0012737	17.218	9.296
979.62	1.369	0.0010571	13.013	10.208	1077.59	1.367	0.0012000	16.250	9.280
981.16	1.369	0.0011259	13.882	10.192	1079.45	1.367	0.0010589	14.364	9.264
984.25	1.369	0.0018804	23.258	10.160	1081.31	1.367	0.0009110	12.379	9.248
985.80	1.369	0.0019651	24.344	10.144	1083.19	1.367	0.0008293	11.288	9.232
987.36	1.369	0.0019955	24.760	10.128	1085.07	1.368	0.0007819	10.661	9.216
988.92	1.368	0.0021384	26.574	10.112	1086.96	1.368	0.0006860	9.370	9.200
990.49	1.368	0.0017673	21.997	10.096	1088.85	1.368	0.0006249	8.550	9.184
992.06	1.368	0.0015074	18.792	10.080	1090.75	1.368	0.0005997	8.219	9.168
993.64	1.368	0.0016320	20.378	10.064	1092.66	1.368	0.0005791	7.951	9.152
995.22	1.368	0.0013606	17.016	10.048	1094.57	1.368	0.0005466	7.518	9.136
996.81	1.369	0.0011905	14.913	10.032	1096.49	1.368	0.0004980	6.862	9.120
998.40	1.369	0.0014898	18.691	10.016	1098.42	1.368	0.0004591	6.337	9.104
1000.00	1.369	0.0015330	19.264	10.000	1100.35	1.369	0.0004612	6.378	9.088
1001.60	1.369	0.0013595	17.111	9.984	1102.29	1.369	0.0004818	6.674	9.072
1003.21	1.370	0.0018569	23.410	9.968	1104.24	1.369	0.0005184	7.193	9.056
1004.82	1.370	0.0024403	30.813	9.952	1106.19	1.369	0.0005093	7.080	9.040
1006.44	1.369	0.0024196	30.601	9.936	1108.16	1.369	0.0004997	6.959	9.024
1008.06	1.369	0.0028665	36.312	9.920	1110.12	1.369	0.0005118	7.139	9.008
1009.69	1.369	0.0034099	43.265	9.904	1112.10	1.369	0.0005775	8.071	8.992
1011.33	1.368	0.0032241	40.975	9.888	1114.08	1.369	0.0007024	9.833	8.976
1012.97	1.368	0.0029017	36.936	9.872	1116.07	1.370	0.0007261	10.183	8.960
1014.61	1.367	0.0026172	33.369	9.856	1118.07	1.370	0.0007681	10.792	8.944
1016.26	1.367	0.0020173	25.763	9.840	1120.07	1.370	0.0009319	13.116	8.928
1017.92	1.367	0.0014293	18.283	9.824	1122.08	1.370	0.0011097	15.648	8.912
1019.58	1.368	0.0011296	14.473	9.808	1124.10	1.370	0.0013809	19.507	8.896
1021.24	1.368	0.0008799	11.293	9.792	1126.13	1.370	0.0017322	24.512	8.880
1022.91	1.369	0.0007688	9.883	9.776	1128.16	1.370	0.0022810	32.337	8.864
1024.59	1.369	0.0009599	12.359	9.760	1130.20	1.370	0.0024992	35.494	8.848
1026.27	1.369	0.0011000	14.186	9.744	1132.25	1.370	0.0032156	45.752	8.832
1027.96	1.370	0.0015296	19.759	9.728	1134.30	1.369	0.0035356	50.397	8.816
1029.65	1.370	0.0022805	29.507	9.712	1136.36	1.368	0.0031389	44.824	8.800
1031.35	1.370	0.0026725	34.636	9.696	1138.43	1.368	0.0026374	37.730	8.784
1033.06	1.370	0.0030754	39.924	9.680	1140.51	1.368	0.0020553	29.456	8.768
1034.77	1.369	0.0034760	45.199	9.664	1142.60	1.368	0.0012939	18.578	8.752
1036.48	1.368	0.0031182	40.614	9.648	1144.69	1.368	0.0012652	18.199	8.736
1038.21	1.368	0.0029360	38.305	9.632	1146.79	1.368	0.0011729	16.903	8.720
1039.93	1.368	0.0027434	35.851	9.616	1148.90	1.368	0.0010532	15.205	8.704
1041.67	1.368	0.0020548	26.897	9.600	1151.01	1.369	0.0009452	13.671	8.688
1043.41	1.368	0.0017983	23.579	9.584	1153.14	1.369	0.0008441	12.232	8.672
1045.15	1.368	0.0013698	17.991	9.568	1155.27	1.369	0.0008255	11.985	8.656
1046.90	1.369	0.0012973	17.067	9.552	1157.41	1.369	0.0008110	11.796	8.640
1048.66	1.369	0.0015253	20.100	9.536	1159.55	1.369	0.0008176	11.913	8.624
1050.42	1.370	0.0018655	24.624	9.520	1161.71	1.369	0.0007979	11.647	8.608
1052.19	1.370	0.0025687	33.964	9.504	1163.87	1.369	0.0007418	10.849	8.592
1053.96	1.370	0.0033235	44.018	9.488	1166.04	1.369	0.0007044	10.322	8.576
1055.74	1.369	0.0034907	46.310	9.472	1168.22	1.369	0.0006858	10.067	8.560
1057.53	1.369	0.0038879	51.667	9.456	1170.41	1.369	0.0006646	9.776	8.544

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1172.61	1.369	0.0006023	8.875	8.528	1310.27	1.375	0.0023306	38.373	7.632
1174.81	1.370	0.0005475	8.083	8.512	1313.03	1.376	0.0023374	38.566	7.616
1177.02	1.370	0.0005288	7.821	8.496	1315.79	1.376	0.0021578	35.678	7.600
1179.25	1.370	0.0005143	7.621	8.480	1318.57	1.376	0.0019344	32.053	7.584
1181.47	1.370	0.0005213	7.740	8.464	1321.35	1.377	0.0016262	27.003	7.568
1183.71	1.370	0.0005299	7.882	8.448	1324.15	1.378	0.0016291	27.108	7.552
1185.96	1.370	0.0005325	7.936	8.432	1326.96	1.379	0.0020361	33.952	7.536
1188.21	1.370	0.0005275	7.876	8.416	1329.79	1.380	0.0025677	42.908	7.520
1190.48	1.370	0.0005364	8.025	8.400	1332.62	1.381	0.0034298	57.435	7.504
1192.75	1.371	0.0005578	8.360	8.384	1335.47	1.383	0.0044365	74.454	7.488
1195.03	1.371	0.0006013	9.029	8.368	1349.89	1.383	0.0133436	226.351	7.408
1197.32	1.371	0.0006565	9.878	8.352	1352.81	1.382	0.0137683	234.060	7.392
1199.62	1.371	0.0006910	10.417	8.336	1355.75	1.382	0.0160003	272.595	7.376
1201.92	1.371	0.0008209	12.399	8.320	1358.70	1.380	0.0174628	298.159	7.360
1204.24	1.371	0.0008860	13.407	8.304	1361.66	1.377	0.0174439	298.485	7.344
1206.56	1.371	0.0009961	15.103	8.288	1364.63	1.377	0.0157195	269.566	7.328
1208.90	1.372	0.0011682	17.747	8.272	1367.61	1.377	0.0163233	280.531	7.312
1211.24	1.371	0.0018514	28.179	8.256	1370.61	1.377	0.0163160	281.020	7.296
1213.59	1.371	0.0018628	28.408	8.240	1373.63	1.377	0.0168333	290.570	7.280
1215.95	1.371	0.0016829	25.715	8.224	1376.65	1.376	0.0187872	325.010	7.264
1218.32	1.370	0.0012455	19.068	8.208	1379.69	1.374	0.0200793	348.130	7.248
1220.70	1.371	0.0008578	13.158	8.192	1382.74	1.372	0.0187189	325.260	7.232
1223.09	1.371	0.0006646	10.214	8.176	1385.81	1.371	0.0172649	300.661	7.216
1225.49	1.371	0.0004905	7.554	8.160	1388.89	1.371	0.0170425	297.448	7.200
1227.90	1.372	0.0006416	9.900	8.144	1391.98	1.371	0.0170530	298.293	7.184
1230.31	1.372	0.0007957	12.302	8.128	1395.09	1.371	0.0171308	300.324	7.168
1232.74	1.372	0.0011398	17.656	8.112	1398.21	1.370	0.0181085	318.175	7.152
1235.18	1.372	0.0015674	24.329	8.096	1401.35	1.368	0.0176251	310.377	7.136
1237.62	1.372	0.0019483	30.301	8.080	1404.49	1.367	0.0158759	280.200	7.120
1240.08	1.372	0.0022039	34.344	8.064	1407.66	1.367	0.0134045	237.115	7.104
1242.54	1.372	0.0023167	36.173	8.048	1410.84	1.369	0.0121265	214.993	7.088
1245.02	1.371	0.0020026	31.331	8.032	1414.03	1.371	0.0123445	219.352	7.072
1247.50	1.371	0.0012562	19.693	8.016	1417.23	1.371	0.0129176	230.055	7.056
1250.00	1.371	0.0008359	13.130	8.000	1420.45	1.372	0.0123522	220.486	7.040
1252.51	1.372	0.0005019	7.899	7.984	1423.69	1.374	0.0112342	200.986	7.024
1255.02	1.373	0.0006204	9.784	7.968	1426.94	1.377	0.0135558	243.076	7.008
1257.55	1.373	0.0010401	16.437	7.952	1430.21	1.378	0.0149806	269.239	6.992
1260.08	1.373	0.0014109	22.341	7.936	1433.49	1.380	0.0180602	325.333	6.976
1262.63	1.373	0.0016038	25.447	7.920	1436.78	1.381	0.0209882	378.945	6.960
1265.18	1.373	0.0015277	24.288	7.904	1440.09	1.381	0.0253258	458.313	6.944
1267.75	1.373	0.0012346	19.669	7.888	1443.42	1.381	0.0293147	531.726	6.928
1270.33	1.373	0.0010266	16.389	7.872	1446.76	1.379	0.0347823	632.361	6.912
1272.91	1.374	0.0009121	14.589	7.856	1450.12	1.376	0.0397589	724.516	6.896
1275.51	1.374	0.0010289	16.492	7.840	1453.49	1.370	0.0462671	845.073	6.880
1278.12	1.375	0.0015801	25.379	7.824	1456.88	1.360	0.0500093	915.555	6.864
1280.74	1.375	0.0023219	37.370	7.808	1460.28	1.349	0.0476155	873.765	6.848
1283.37	1.375	0.0029312	47.272	7.792	1463.70	1.339	0.0415944	765.062	6.832
1286.01	1.375	0.0035525	57.411	7.776	1467.14	1.333	0.0322226	594.075	6.816
1288.66	1.374	0.0037682	61.022	7.760	1470.59	1.332	0.0215975	399.122	6.800
1291.32	1.374	0.0032761	53.161	7.744	1474.06	1.335	0.0152603	282.676	6.784
1294.00	1.374	0.0027658	44.975	7.728	1477.54	1.338	0.0125297	232.643	6.768
1296.68	1.374	0.0024084	39.244	7.712	1481.04	1.340	0.0086119	160.278	6.752
1299.38	1.374	0.0021617	35.297	7.696	1484.56	1.343	0.0069663	129.959	6.736
1302.08	1.375	0.0021984	35.970	7.680	1488.10	1.344	0.0061177	114.400	6.720
1304.80	1.375	0.0023189	38.022	7.664	1491.65	1.345	0.0039792	74.589	6.704
1307.53	1.375	0.0022689	37.280	7.648	1495.22	1.347	0.0031691	59.546	6.688

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1498.80	1.349	0.0025157	47.381	6.672	1755.62	1.364	0.0001592	3.513	5.696
1502.40	1.350	0.0020273	38.275	6.656	1760.56	1.364	0.0001800	3.983	5.680
1506.02	1.351	0.0019100	36.147	6.640	1765.54	1.364	0.0001868	4.144	5.664
1509.66	1.352	0.0019929	37.808	6.624	1770.54	1.364	0.0001861	4.140	5.648
1513.32	1.353	0.0018773	35.701	6.608	1775.57	1.364	0.0001731	3.861	5.632
1516.99	1.353	0.0016439	31.338	6.592	1780.63	1.364	0.0001600	3.579	5.616
1520.68	1.354	0.0013006	24.853	6.576	1785.71	1.364	0.0001435	3.221	5.600
1535.63	1.356	0.0011754	22.681	6.512	1790.83	1.364	0.0001256	2.827	5.584
1539.41	1.357	0.0010913	21.110	6.496	1795.98	1.364	0.0001090	2.461	5.568
1543.21	1.357	0.0010154	19.690	6.480	1801.15	1.364	0.0001005	2.274	5.552
1547.03	1.357	0.0009521	18.510	6.464	1806.36	1.364	0.0000949	2.154	5.536
1550.87	1.358	0.0008857	17.261	6.448	1811.59	1.364	0.0000848	1.931	5.520
1554.73	1.358	0.0008516	16.638	6.432	1816.86	1.364	0.0000803	1.832	5.504
1558.60	1.358	0.0007755	15.190	6.416	1822.16	1.364	0.0000745	1.706	5.488
1562.50	1.358	0.0007389	14.508	6.400	1827.49	1.364	0.0000739	1.696	5.472
1566.42	1.359	0.0007089	13.954	6.384	1832.84	1.364	0.0000797	1.835	5.456
1570.35	1.359	0.0006785	13.389	6.368	1838.24	1.364	0.0000896	2.070	5.440
1574.31	1.359	0.0006470	12.801	6.352	1843.66	1.364	0.0000903	2.093	5.424
1578.28	1.359	0.0006228	12.351	6.336	1849.11	1.365	0.0000906	2.104	5.408
1582.28	1.360	0.0005900	11.731	6.320	1851.85	1.365	0.0000866	2.014	5.400
1586.29	1.360	0.0005731	11.424	6.304	1854.60	1.365	0.0000896	2.089	5.392
1590.33	1.360	0.0005524	11.039	6.288	1857.36	1.365	0.0000888	2.072	5.384
1594.39	1.360	0.0005510	11.039	6.272	1860.12	1.365	0.0000869	2.031	5.376
1598.47	1.360	0.0005530	11.109	6.256	1862.89	1.365	0.0000840	1.967	5.368
1602.56	1.360	0.0005597	11.271	6.240	1865.67	1.365	0.0000890	2.087	5.360
1606.68	1.361	0.0005617	11.341	6.224	1868.46	1.365	0.0000943	2.214	5.352
1610.82	1.361	0.0005574	11.284	6.208	1871.26	1.365	0.0001011	2.377	5.344
1614.99	1.361	0.0005277	10.710	6.192	1874.06	1.365	0.0001060	2.496	5.336
1619.17	1.361	0.0004945	10.062	6.176	1876.88	1.365	0.0001166	2.750	5.328
1623.38	1.361	0.0004613	9.410	6.160	1879.70	1.365	0.0001298	3.065	5.320
1627.60	1.361	0.0004412	9.023	6.144	1882.53	1.365	0.0001486	3.516	5.312
1631.85	1.361	0.0004404	9.030	6.128	1885.37	1.365	0.0001633	3.869	5.304
1636.13	1.361	0.0004237	8.712	6.112	1888.22	1.365	0.0001716	4.071	5.296
1640.42	1.362	0.0004156	8.568	6.096	1891.07	1.365	0.0001712	4.068	5.288
1644.74	1.362	0.0003994	8.254	6.080	1893.94	1.365	0.0001635	3.891	5.280
1649.08	1.362	0.0003940	8.164	6.064	1896.81	1.365	0.0001541	3.673	5.272
1653.44	1.362	0.0003947	8.202	6.048	1899.70	1.365	0.0001452	3.466	5.264
1657.82	1.362	0.0004038	8.413	6.032	1902.59	1.365	0.0001345	3.216	5.256
1662.23	1.362	0.0004099	8.562	6.016	1905.49	1.365	0.0001205	2.885	5.248
1675.60	1.362	0.0004087	8.605	5.968	1908.40	1.365	0.0001102	2.643	5.240
1680.11	1.362	0.0004138	8.737	5.952	1911.31	1.365	0.0001001	2.404	5.232
1684.64	1.362	0.0004144	8.772	5.936	1914.24	1.365	0.0000971	2.335	5.224
1689.19	1.363	0.0003991	8.471	5.920	1917.18	1.365	0.0000916	2.206	5.216
1693.77	1.363	0.0003567	7.592	5.904	1920.12	1.365	0.0000880	2.122	5.208
1698.37	1.363	0.0003321	7.087	5.888	1923.08	1.365	0.0000866	2.093	5.200
1703.00	1.363	0.0002993	6.406	5.872	1926.04	1.365	0.0000852	2.063	5.192
1707.65	1.363	0.0002664	5.717	5.856	1929.01	1.365	0.0000867	2.101	5.184
1712.33	1.363	0.0002373	5.107	5.840	1931.99	1.365	0.0000871	2.114	5.176
1717.03	1.363	0.0002291	4.944	5.824	1934.98	1.365	0.0000863	2.098	5.168
1721.76	1.363	0.0002209	4.779	5.808	1937.98	1.365	0.0000879	2.140	5.160
1726.52	1.363	0.0002109	4.575	5.792	1940.99	1.365	0.0000897	2.187	5.152
1731.30	1.363	0.0001906	4.147	5.776	1944.01	1.365	0.0000937	2.290	5.144
1736.11	1.363	0.0001841	4.017	5.760	1947.04	1.365	0.0000954	2.333	5.136
1740.95	1.363	0.0001659	3.630	5.744	1950.08	1.365	0.0000927	2.272	5.128
1745.81	1.363	0.0001550	3.400	5.728	1953.13	1.365	0.0000886	2.176	5.120
1750.70	1.363	0.0001474	3.242	5.712	1956.18	1.365	0.0000836	2.055	5.112

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1959.25	1.365	0.0000802	1.975	5.104	2147.77	1.367	0.0001846	4.984	4.656
1962.32	1.365	0.0000776	1.915	5.096	2151.46	1.367	0.0001949	5.270	4.648
1965.41	1.365	0.0000739	1.826	5.088	2155.17	1.367	0.0002052	5.558	4.640
1968.50	1.365	0.0000721	1.784	5.080	2158.89	1.367	0.0002145	5.820	4.632
1971.61	1.365	0.0000721	1.786	5.072	2162.63	1.367	0.0002228	6.054	4.624
1974.72	1.365	0.0000736	1.825	5.064	2166.38	1.367	0.0002309	6.286	4.616
1977.85	1.366	0.0000735	1.827	5.056	2170.14	1.367	0.0002411	6.575	4.608
1980.98	1.366	0.0000736	1.833	5.048	2173.91	1.367	0.0002489	6.800	4.600
1984.13	1.366	0.0000746	1.860	5.040	2177.70	1.367	0.0002557	6.997	4.592
1987.28	1.366	0.0000774	1.933	5.032	2181.50	1.367	0.0002579	7.070	4.584
1990.45	1.366	0.0000806	2.017	5.024	2185.31	1.367	0.0002574	7.069	4.576
1993.62	1.366	0.0000876	2.195	5.016	2189.14	1.367	0.0002576	7.086	4.568
1996.81	1.366	0.0000946	2.374	5.008	2192.98	1.367	0.0002516	6.934	4.560
2000.00	1.366	0.0001040	2.615	5.000	2196.84	1.367	0.0002453	6.773	4.552
2003.21	1.366	0.0001177	2.962	4.992	2200.70	1.367	0.0002343	6.480	4.544
2006.42	1.366	0.0001328	3.348	4.984	2204.59	1.367	0.0002240	6.205	4.536
2009.65	1.366	0.0001536	3.879	4.976	2208.48	1.367	0.0002145	5.952	4.528
2012.88	1.366	0.0001747	4.420	4.968	2212.39	1.367	0.0002064	5.738	4.520
2016.13	1.366	0.0001943	4.921	4.960	2216.31	1.367	0.0001995	5.556	4.512
2019.39	1.366	0.0002092	5.309	4.952	2220.25	1.367	0.0001960	5.468	4.504
2022.65	1.366	0.0002174	5.526	4.944	2224.20	1.367	0.0001967	5.498	4.496
2025.93	1.366	0.0002180	5.549	4.936	2228.16	1.367	0.0002011	5.632	4.488
2029.22	1.366	0.0002166	5.523	4.928	2232.14	1.367	0.0002075	5.820	4.480
2032.52	1.366	0.0002116	5.404	4.920	2236.14	1.367	0.0002179	6.122	4.472
2035.83	1.366	0.0002024	5.179	4.912	2240.14	1.367	0.0002291	6.449	4.464
2039.15	1.366	0.0001933	4.953	4.904	2244.17	1.367	0.0002387	6.732	4.456
2042.48	1.366	0.0001832	4.702	4.896	2248.20	1.367	0.0002418	6.832	4.448
2045.83	1.366	0.0001725	4.434	4.888	2252.25	1.367	0.0002459	6.959	4.440
2049.18	1.366	0.0001627	4.190	4.880	2256.32	1.367	0.0002478	7.025	4.432
2052.55	1.366	0.0001507	3.888	4.872	2260.40	1.367	0.0002472	7.023	4.424
2055.92	1.366	0.0001396	3.608	4.864	2264.49	1.367	0.0002428	6.910	4.416
2059.31	1.366	0.0001294	3.349	4.856	2268.60	1.367	0.0002357	6.719	4.408
2062.71	1.366	0.0001203	3.118	4.848	2272.73	1.367	0.0002271	6.487	4.400
2066.12	1.366	0.0001147	2.978	4.840	2276.87	1.367	0.0002220	6.352	4.392
2069.54	1.366	0.0001096	2.849	4.832	2281.02	1.367	0.0002193	6.285	4.384
2072.97	1.366	0.0001053	2.743	4.824	2285.19	1.368	0.0002162	6.209	4.376
2076.41	1.366	0.0001018	2.657	4.816	2289.38	1.368	0.0002173	6.251	4.368
2079.87	1.366	0.0000977	2.554	4.808	2293.58	1.368	0.0002267	6.535	4.360
2083.33	1.366	0.0000966	2.528	4.800	2297.79	1.368	0.0002311	6.672	4.352
2086.81	1.366	0.0000963	2.526	4.792	2302.03	1.368	0.0002397	6.935	4.344
2090.30	1.366	0.0000997	2.619	4.784	2306.27	1.368	0.0002555	7.403	4.336
2093.80	1.366	0.0001019	2.680	4.776	2310.54	1.368	0.0002662	7.729	4.328
2097.32	1.366	0.0001054	2.778	4.768	2314.81	1.368	0.0002742	7.977	4.320
2100.84	1.366	0.0001086	2.868	4.760	2319.11	1.368	0.0002867	8.356	4.312
2104.38	1.366	0.0001115	2.949	4.752	2323.42	1.368	0.0002965	8.656	4.304
2107.93	1.366	0.0001163	3.080	4.744	2327.75	1.368	0.0003119	9.124	4.296
2111.49	1.366	0.0001182	3.136	4.736	2332.09	1.368	0.0003343	9.796	4.288
2115.06	1.366	0.0001215	3.228	4.728	2336.45	1.368	0.0003592	10.547	4.280
2118.64	1.366	0.0001269	3.379	4.720	2340.82	1.368	0.0003677	10.816	4.272
2122.24	1.366	0.0001334	3.558	4.712	2345.22	1.368	0.0003753	11.061	4.264
2125.85	1.366	0.0001400	3.741	4.704	2349.62	1.368	0.0003845	11.352	4.256
2129.47	1.367	0.0001450	3.881	4.696	2354.05	1.368	0.0003848	11.383	4.248
2133.11	1.367	0.0001518	4.068	4.688	2358.49	1.368	0.0003806	11.281	4.240
2136.75	1.367	0.0001609	4.320	4.680	2362.95	1.368	0.0003764	11.176	4.232
2140.41	1.367	0.0001702	4.577	4.672	2367.42	1.368	0.0003567	10.613	4.224
2144.08	1.367	0.0001785	4.810	4.664	2371.92	1.368	0.0003372	10.051	4.216

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2376.43	1.368	0.0003278	9.791	4.208	2659.57	1.374	0.0011849	39.599	3.760
2380.95	1.368	0.0003081	9.220	4.200	2665.25	1.374	0.0011920	39.924	3.752
2385.50	1.368	0.0002989	8.960	4.192	2670.94	1.374	0.0011906	39.962	3.744
2390.06	1.368	0.0002907	8.731	4.184	2676.66	1.374	0.0011700	39.355	3.736
2394.64	1.368	0.0002828	8.509	4.176	2682.40	1.375	0.0011280	38.024	3.728
2399.23	1.368	0.0002787	8.403	4.168	2688.17	1.375	0.0011146	37.653	3.720
2403.85	1.368	0.0002775	8.383	4.160	2693.97	1.375	0.0011446	38.748	3.712
2408.48	1.369	0.0002743	8.301	4.152	2699.78	1.376	0.0012027	40.804	3.704
2413.13	1.369	0.0002664	8.077	4.144	2705.63	1.376	0.0012578	42.766	3.696
2417.79	1.369	0.0002555	7.763	4.136	2711.50	1.376	0.0013499	45.997	3.688
2422.48	1.369	0.0002450	7.458	4.128	2717.39	1.377	0.0014139	48.281	3.680
2427.18	1.369	0.0002344	7.149	4.120	2723.31	1.377	0.0014579	49.891	3.672
2431.91	1.369	0.0002219	6.783	4.112	2729.26	1.378	0.0014732	50.524	3.664
2436.65	1.369	0.0002121	6.493	4.104	2735.23	1.378	0.0014801	50.875	3.656
2441.41	1.369	0.0002036	6.248	4.096	2741.23	1.379	0.0014941	51.467	3.648
2446.18	1.369	0.0001990	6.117	4.088	2747.25	1.379	0.0015268	52.711	3.640
2450.98	1.369	0.0001960	6.038	4.080	2753.30	1.380	0.0015802	54.673	3.632
2455.80	1.369	0.0001961	6.053	4.072	2759.38	1.381	0.0016415	56.921	3.624
2460.63	1.369	0.0001985	6.137	4.064	2765.49	1.382	0.0017669	61.403	3.616
2465.48	1.369	0.0002020	6.260	4.056	2771.62	1.383	0.0019466	67.797	3.608
2470.36	1.369	0.0002066	6.414	4.048	2777.78	1.385	0.0022141	77.288	3.600
2475.25	1.369	0.0002135	6.642	4.040	2783.96	1.387	0.0027522	96.285	3.592
2480.16	1.370	0.0002242	6.988	4.032	2790.18	1.389	0.0031293	109.721	3.584
2485.09	1.370	0.0002344	7.319	4.024	2796.42	1.391	0.0069437	244.009	3.576
2490.04	1.370	0.0002425	7.589	4.016	2802.69	1.392	0.0082050	288.978	3.568
2495.01	1.370	0.0002479	7.774	4.008	2808.99	1.393	0.0097518	344.225	3.560
2500.00	1.370	0.0002531	7.951	4.000	2815.32	1.395	0.0119780	423.762	3.552
2505.01	1.370	0.0002574	8.103	3.992	2821.67	1.397	0.0147323	522.381	3.544
2510.04	1.370	0.0002635	8.312	3.984	2828.05	1.398	0.0181490	644.986	3.536
2515.09	1.370	0.0002700	8.535	3.976	2834.47	1.399	0.0225236	802.268	3.528
2520.16	1.370	0.0002774	8.784	3.968	2840.91	1.398	0.0270242	964.761	3.520
2525.25	1.370	0.0002872	9.112	3.960	2847.38	1.397	0.0313803	1122.825	3.512
2530.36	1.370	0.0003028	9.628	3.952	2853.88	1.395	0.0359024	1287.565	3.504
2535.50	1.371	0.0003329	10.607	3.944	2860.41	1.392	0.0406157	1459.932	3.496
2540.65	1.371	0.0003398	10.850	3.936	2866.97	1.387	0.0419774	1512.336	3.488
2545.82	1.371	0.0003615	11.565	3.928	2873.56	1.382	0.0431947	1559.771	3.480
2551.02	1.371	0.0003913	12.545	3.920	2880.18	1.379	0.0408783	1479.526	3.472
2556.24	1.371	0.0004378	14.062	3.912	2886.84	1.380	0.0408292	1481.166	3.464
2561.48	1.371	0.0004964	15.979	3.904	2893.52	1.380	0.0436864	1588.484	3.456
2566.74	1.371	0.0005553	17.911	3.896	2900.23	1.379	0.0469433	1710.864	3.448
2572.02	1.371	0.0005745	18.570	3.888	2906.98	1.378	0.0509979	1862.963	3.440
2577.32	1.372	0.0006432	20.832	3.880	2913.75	1.374	0.0583956	2138.169	3.432
2582.64	1.372	0.0006996	22.704	3.872	2920.56	1.365	0.0654718	2402.870	3.424
2587.99	1.372	0.0007540	24.522	3.864	2927.40	1.352	0.0659278	2425.274	3.416
2593.36	1.372	0.0008004	26.085	3.856	2934.27	1.338	0.0644842	2377.733	3.408
2598.75	1.372	0.0008274	27.021	3.848	2941.18	1.324	0.0542465	2004.949	3.400
2604.17	1.372	0.0008413	27.532	3.840	2948.11	1.318	0.0365044	1352.380	3.392
2609.60	1.372	0.0008416	27.599	3.832	2955.08	1.321	0.0272566	1012.162	3.384
2615.06	1.372	0.0008594	28.243	3.824	2962.09	1.323	0.0195002	725.850	3.376
2620.55	1.373	0.0008726	28.736	3.816	2969.12	1.326	0.0143430	535.154	3.368
2626.05	1.373	0.0008982	29.641	3.808	2976.19	1.329	0.0097532	364.768	3.360
2631.58	1.373	0.0009318	30.812	3.800	2983.29	1.333	0.0064370	241.318	3.352
2637.13	1.373	0.0009795	32.460	3.792	2990.43	1.336	0.0051121	192.107	3.344
2642.71	1.373	0.0010378	34.465	3.784	2997.60	1.339	0.0041298	155.567	3.336
2648.31	1.373	0.0010980	36.541	3.776	3004.81	1.341	0.0035347	133.468	3.328
2653.93	1.374	0.0011550	38.519	3.768	3012.05	1.343	0.0030029	113.662	3.320

HEXANE					HEXANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3019.32	1.344	0.0025046	95.028	3.312	3491.62	1.361	0.0000354	1.554	2.864
3026.63	1.345	0.0021135	80.384	3.304	3501.40	1.361	0.0000351	1.544	2.856
3033.98	1.347	0.0018060	68.857	3.296	3511.24	1.361	0.0000355	1.568	2.848
3041.36	1.348	0.0015484	59.179	3.288	3521.13	1.361	0.0000364	1.612	2.840
3048.78	1.349	0.0014168	54.280	3.280	3531.07	1.361	0.0000413	1.834	2.832
3056.23	1.349	0.0012501	48.013	3.272	3541.08	1.361	0.0000504	2.242	2.824
3063.73	1.350	0.0011069	42.617	3.264	3551.14	1.361	0.0000589	2.626	2.816
3071.25	1.351	0.0009947	38.389	3.256	3561.25	1.362	0.0000705	3.153	2.808
3078.82	1.351	0.0008924	34.527	3.248	3571.43	1.362	0.0000840	3.769	2.800
3086.42	1.352	0.0008171	31.692	3.240	3581.66	1.362	0.0001005	4.522	2.792
3094.06	1.353	0.0007527	29.265	3.232	3591.95	1.362	0.0001182	5.336	2.784
3101.74	1.353	0.0007034	27.416	3.224	3602.31	1.362	0.0001338	6.056	2.776
3109.45	1.354	0.0006721	26.261	3.216	3612.72	1.362	0.0001473	6.689	2.768
3117.21	1.354	0.0006434	25.204	3.208	3623.19	1.362	0.0001551	7.063	2.760
3125.00	1.354	0.0006175	24.251	3.200	3633.72	1.362	0.0001611	7.354	2.752
3132.83	1.355	0.0006061	23.860	3.192	3644.31	1.362	0.0001624	7.438	2.744
3140.70	1.355	0.0005946	23.468	3.184	3654.97	1.362	0.0001598	7.342	2.736
3148.61	1.355	0.0005781	22.874	3.176	3665.69	1.362	0.0001580	7.278	2.728
3156.57	1.356	0.0005715	22.668	3.168	3676.47	1.362	0.0001560	7.206	2.720
3164.56	1.356	0.0005579	22.185	3.160	3687.32	1.362	0.0001553	7.196	2.712
3172.59	1.356	0.0005302	21.140	3.152	3698.22	1.362	0.0001554	7.220	2.704
3180.66	1.356	0.0004939	19.740	3.144	3709.20	1.362	0.0001575	7.340	2.696
3188.78	1.357	0.0004530	18.154	3.136	3720.24	1.362	0.0001632	7.631	2.688
3196.93	1.357	0.0004466	17.943	3.128	3731.34	1.362	0.0001678	7.868	2.680
3205.13	1.357	0.0003887	15.654	3.120	3742.51	1.362	0.0001715	8.065	2.672
3213.37	1.357	0.0003361	13.572	3.112	3753.75	1.362	0.0001742	8.215	2.664
3221.65	1.357	0.0002919	11.818	3.104	3765.06	1.362	0.0001755	8.302	2.656
3229.97	1.358	0.0002556	10.376	3.096	3776.44	1.362	0.0001754	8.323	2.648
3238.34	1.358	0.0002249	9.152	3.088	3787.88	1.362	0.0001728	8.226	2.640
3246.75	1.358	0.0002003	8.172	3.080	3799.39	1.363	0.0001709	8.160	2.632
3255.21	1.358	0.0001816	7.429	3.072	3810.98	1.363	0.0001692	8.101	2.624
3263.71	1.358	0.0001630	6.684	3.064	3822.63	1.363	0.0001693	8.134	2.616
3272.25	1.358	0.0001508	6.202	3.056	3834.36	1.363	0.0001634	7.872	2.608
3280.84	1.359	0.0001412	5.822	3.048	3846.15	1.363	0.0001639	7.922	2.600
3289.47	1.359	0.0001323	5.468	3.040	3858.02	1.363	0.0001683	8.162	2.592
3298.15	1.359	0.0001248	5.171	3.032	3869.97	1.363	0.0001744	8.481	2.584
3306.88	1.359	0.0001208	5.022	3.024	3881.99	1.363	0.0001760	8.587	2.576
3315.65	1.359	0.0001197	4.985	3.016	3894.08	1.363	0.0001902	9.307	2.568
3324.47	1.359	0.0001183	4.943	3.008	3906.25	1.363	0.0001914	9.395	2.560
3333.33	1.359	0.0001177	4.930	3.000	4000.00	1.363	0.0006036	30.341	2.500
3342.25	1.360	0.0001178	4.949	2.992	4100.00	1.363	0.0006504	33.512	2.439
3351.21	1.360	0.0001182	4.978	2.984	4200.00	1.363	0.0006507	34.342	2.381
3360.22	1.360	0.0001171	4.945	2.976	4347.00	1.363	0.0006590	36.000	2.300
3369.27	1.360	0.0001135	4.807	2.968	4400.00	1.363	0.0006006	33.208	2.273
3378.38	1.360	0.0001097	4.659	2.960	4500.00	1.363	0.0004941	27.940	2.222
3387.53	1.360	0.0001048	4.463	2.952	4600.00	1.363	0.0003922	22.672	2.174
3396.74	1.360	0.0001004	4.284	2.944	4700.00	1.363	0.0002947	17.404	2.128
3405.99	1.360	0.0000934	3.996	2.936	4800.00	1.364	0.0002012	12.136	2.083
3415.30	1.360	0.0000857	3.678	2.928	4900.00	1.364	0.0001115	6.868	2.041
3424.66	1.360	0.0000768	3.306	2.920	5000.00	1.364	0.0000255	1.600	2.000
3434.07	1.360	0.0000677	2.921	2.912					
3443.53	1.361	0.0000600	2.597	2.904					
3453.04	1.361	0.0000545	2.364	2.896					
3462.60	1.361	0.0000494	2.151	2.888					
3472.22	1.361	0.0000423	1.845	2.880					
3481.89	1.361	0.0000379	1.657	2.872					

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
670.00	1.384	0.0002138	1.800	14.925	767.81	1.378	0.0063215	60.993	13.024
680.00	1.385	0.0003511	3.000	14.706	768.76	1.378	0.0062643	60.516	13.008
690.00	1.387	0.0008534	7.400	14.493	770.65	1.377	0.0065538	63.469	12.976
700.00	1.389	0.0023305	20.500	14.286	771.60	1.376	0.0059507	57.699	12.960
714.29	1.393	0.0079693	71.533	14.000	772.56	1.376	0.0054936	53.333	12.944
715.10	1.395	0.0084916	76.307	13.984	774.47	1.376	0.0047173	45.910	12.912
715.92	1.397	0.0095802	86.189	13.968	775.43	1.376	0.0041918	40.846	12.896
716.74	1.399	0.0126335	113.787	13.952	778.33	1.376	0.0036643	35.840	12.848
717.57	1.399	0.0158397	142.830	13.936	781.25	1.376	0.0035099	34.458	12.800
718.39	1.397	0.0201053	181.502	13.920	782.23	1.376	0.0034568	33.980	12.784
719.22	1.393	0.0206127	186.298	13.904	783.21	1.376	0.0032867	32.348	12.768
720.05	1.391	0.0205999	186.397	13.888	784.19	1.376	0.0034347	33.847	12.752
720.88	1.391	0.0217601	197.122	13.872	785.18	1.376	0.0029934	29.535	12.736
722.54	1.384	0.0271890	246.868	13.840	786.16	1.376	0.0029076	28.725	12.720
723.38	1.379	0.0231430	210.376	13.824	787.15	1.376	0.0025791	25.511	12.704
724.22	1.378	0.0216145	196.709	13.808	788.15	1.376	0.0023131	22.909	12.688
725.06	1.377	0.0205690	187.412	13.792	789.14	1.376	0.0020942	20.767	12.672
725.90	1.375	0.0199091	181.610	13.776	790.14	1.376	0.0015555	15.445	12.656
726.74	1.373	0.0175695	160.453	13.760	791.14	1.376	0.0013865	13.785	12.640
727.59	1.372	0.0149191	136.408	13.744	792.14	1.376	0.0011856	11.802	12.624
728.44	1.372	0.0131301	120.191	13.728	793.15	1.377	0.0011322	11.285	12.608
729.29	1.373	0.0110685	101.438	13.712	794.16	1.377	0.0011028	11.006	12.592
730.14	1.374	0.0102522	94.066	13.696	795.17	1.377	0.0009260	9.253	12.576
730.99	1.375	0.0101877	93.583	13.680	796.18	1.377	0.0009101	9.106	12.560
733.57	1.375	0.0097983	90.324	13.632	797.19	1.377	0.0008885	8.901	12.544
734.43	1.375	0.0095850	88.461	13.616	799.23	1.378	0.0008276	8.312	12.512
736.16	1.375	0.0093589	86.578	13.584	801.28	1.378	0.0007971	8.026	12.480
739.65	1.374	0.0088042	81.832	13.520	802.31	1.378	0.0007672	7.735	12.464
740.52	1.374	0.0078121	72.696	13.504	804.38	1.378	0.0007636	7.719	12.432
741.40	1.374	0.0070814	65.975	13.488	807.49	1.378	0.0007474	7.584	12.384
744.05	1.374	0.0067300	62.926	13.440	808.54	1.379	0.0007707	7.831	12.368
744.93	1.374	0.0060474	56.611	13.424	810.64	1.379	0.0007915	8.063	12.336
745.82	1.374	0.0051613	48.373	13.408	812.74	1.379	0.0008337	8.515	12.304
746.71	1.374	0.0045111	42.330	13.392	813.80	1.379	0.0008332	8.521	12.288
747.61	1.374	0.0041351	38.849	13.376	814.86	1.379	0.0008205	8.402	12.272
748.50	1.375	0.0038619	36.325	13.360	815.93	1.379	0.0008788	9.011	12.256
749.40	1.375	0.0033509	31.556	13.344	816.99	1.379	0.0009248	9.495	12.240
750.30	1.375	0.0029023	27.365	13.328	819.14	1.379	0.0009622	9.904	12.208
751.20	1.376	0.0025830	24.383	13.312	820.21	1.379	0.0010783	11.114	12.192
752.11	1.376	0.0026287	24.845	13.296	821.29	1.380	0.0010953	11.304	12.176
753.01	1.377	0.0024029	22.738	13.280	822.37	1.380	0.0011680	12.070	12.160
753.92	1.377	0.0021603	20.467	13.264	823.45	1.380	0.0013610	14.084	12.144
754.83	1.378	0.0026304	24.951	13.248	824.54	1.380	0.0014413	14.934	12.128
755.74	1.378	0.0025260	23.989	13.232	825.63	1.380	0.0014651	15.201	12.112
756.66	1.379	0.0029253	27.815	13.216	826.72	1.380	0.0016719	17.369	12.096
757.58	1.379	0.0029680	28.256	13.200	827.81	1.380	0.0017094	17.782	12.080
758.50	1.379	0.0035268	33.616	13.184	828.91	1.379	0.0016964	17.671	12.064
759.42	1.379	0.0038641	36.875	13.168	830.01	1.379	0.0017605	18.363	12.048
760.34	1.379	0.0041449	39.603	13.152	831.12	1.379	0.0018229	19.038	12.032
762.20	1.380	0.0046204	44.255	13.120	832.22	1.379	0.0016884	17.657	12.016
764.06	1.379	0.0056103	53.867	13.088	833.33	1.379	0.0015401	16.128	12.000
764.99	1.379	0.0055577	53.427	13.072	834.45	1.379	0.0015660	16.421	11.984
765.93	1.379	0.0061707	59.393	13.056	835.56	1.379	0.0014320	15.036	11.968
					836.68	1.379	0.0012638	13.288	11.952
					837.80	1.379	0.0012651	13.319	11.936
					838.93	1.379	0.0012461	13.137	11.920

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
840.05	1.379	0.0011383	12.016	11.904	908.43	1.380	0.0020495	23.396	11.008
841.18	1.380	0.0011486	12.141	11.888	909.75	1.380	0.0021849	24.978	10.992
842.32	1.380	0.0011535	12.210	11.872	911.08	1.380	0.0021782	24.939	10.976
843.45	1.380	0.0011191	11.861	11.856	912.41	1.380	0.0022955	26.320	10.960
844.59	1.380	0.0011101	11.782	11.840	913.74	1.380	0.0022519	25.858	10.944
845.74	1.380	0.0011714	12.450	11.824	915.08	1.380	0.0021633	24.876	10.928
846.88	1.380	0.0012260	13.047	11.808	916.42	1.380	0.0021437	24.687	10.912
848.03	1.380	0.0012030	12.820	11.792	917.77	1.380	0.0020730	23.908	10.896
849.18	1.380	0.0013021	13.895	11.776	919.12	1.380	0.0020978	24.229	10.880
850.34	1.380	0.0012827	13.706	11.760	920.47	1.381	0.0021460	24.822	10.864
851.50	1.380	0.0013523	14.470	11.744	921.83	1.381	0.0022963	26.601	10.848
852.66	1.380	0.0014317	15.341	11.728	923.19	1.381	0.0025621	29.723	10.832
853.83	1.380	0.0014041	15.065	11.712	924.56	1.381	0.0028094	32.640	10.816
854.99	1.380	0.0014105	15.155	11.696	925.93	1.381	0.0032069	37.314	10.800
856.16	1.380	0.0015292	16.452	11.680	927.30	1.381	0.0035960	41.903	10.784
857.34	1.380	0.0015252	16.432	11.664	928.68	1.381	0.0037933	44.269	10.768
858.52	1.381	0.0016400	17.693	11.648	930.06	1.380	0.0041629	48.654	10.752
859.70	1.381	0.0020581	22.235	11.632	931.45	1.380	0.0041275	48.312	10.736
860.88	1.380	0.0022011	23.811	11.616	932.84	1.379	0.0042171	49.434	10.720
862.07	1.380	0.0023002	24.918	11.600	934.23	1.379	0.0039876	46.814	10.704
863.26	1.380	0.0023893	25.919	11.584	935.63	1.379	0.0038908	45.746	10.688
864.45	1.380	0.0023001	24.986	11.568	937.03	1.379	0.0037877	44.601	10.672
865.65	1.380	0.0022733	24.729	11.552	938.44	1.378	0.0036019	42.476	10.656
866.85	1.380	0.0021113	22.999	11.536	939.85	1.378	0.0033592	39.674	10.640
868.06	1.380	0.0019525	21.298	11.520	941.27	1.378	0.0032124	37.998	10.624
869.26	1.380	0.0018236	19.920	11.504	942.68	1.378	0.0028209	33.417	10.608
870.47	1.380	0.0017347	18.975	11.488	944.11	1.378	0.0026442	31.370	10.592
871.69	1.380	0.0015546	17.029	11.472	945.54	1.378	0.0022859	27.162	10.576
872.91	1.380	0.0015916	17.459	11.456	946.97	1.378	0.0019303	22.971	10.560
874.13	1.380	0.0013479	14.806	11.440	948.41	1.378	0.0016210	19.320	10.544
875.35	1.380	0.0012972	14.269	11.424	949.85	1.378	0.0013047	15.573	10.528
876.58	1.380	0.0011553	12.726	11.408	951.29	1.378	0.0011746	14.042	10.512
877.81	1.380	0.0008366	9.229	11.392	952.74	1.379	0.0011014	13.187	10.496
879.04	1.380	0.0010120	11.179	11.376	954.20	1.379	0.0011528	13.823	10.480
880.28	1.381	0.0010749	11.891	11.360	955.66	1.379	0.0013089	15.719	10.464
881.52	1.381	0.0011638	12.892	11.344	957.12	1.379	0.0014351	17.261	10.448
882.77	1.381	0.0015674	17.387	11.328	958.59	1.379	0.0016486	19.859	10.432
884.02	1.381	0.0017754	19.723	11.312	960.06	1.379	0.0017699	21.353	10.416
885.27	1.381	0.0020586	22.901	11.296	961.54	1.379	0.0020308	24.538	10.400
886.52	1.381	0.0023410	26.079	11.280	963.02	1.379	0.0020424	24.716	10.384
887.78	1.381	0.0024670	27.522	11.264	964.51	1.379	0.0020278	24.578	10.368
889.05	1.381	0.0026094	29.152	11.248	966.00	1.378	0.0017209	20.890	10.352
890.31	1.381	0.0027292	30.534	11.232	967.49	1.378	0.0013639	16.582	10.336
891.58	1.381	0.0028408	31.828	11.216	968.99	1.378	0.0010907	13.281	10.320
892.86	1.381	0.0028730	32.235	11.200	970.50	1.379	0.0007995	9.751	10.304
894.13	1.380	0.0029965	33.669	11.184	973.52	1.379	0.0007438	9.099	10.272
895.42	1.380	0.0031331	35.254	11.168	975.04	1.379	0.0007441	9.118	10.256
896.70	1.380	0.0030035	33.844	11.152	978.09	1.379	0.0007114	8.743	10.224
897.99	1.380	0.0030480	34.395	11.136	979.62	1.379	0.0007646	9.413	10.208
899.28	1.379	0.0027332	30.887	11.120	984.25	1.380	0.0008031	9.933	10.160
900.58	1.379	0.0024689	27.940	11.104	990.49	1.380	0.0008742	10.880	10.096
901.88	1.379	0.0023388	26.506	11.088	995.22	1.380	0.0008880	11.105	10.048
903.18	1.379	0.0020133	22.851	11.072	996.81	1.380	0.0009038	11.321	10.032
904.49	1.380	0.0018826	21.397	11.056	998.40	1.380	0.0009835	12.339	10.016
905.80	1.380	0.0019694	22.417	11.040	1001.60	1.380	0.0010019	12.610	9.984
907.11	1.380	0.0018814	21.447	11.024	1003.21	1.380	0.0010628	13.398	9.968

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1004.82	1.380	0.0011581	14.624	9.952	1104.24	1.380	0.0006663	9.246	9.056
1006.44	1.381	0.0011146	14.096	9.936	1106.20	1.380	0.0006839	9.506	9.040
1008.07	1.381	0.0012697	16.084	9.920	1108.16	1.381	0.0007018	9.773	9.024
1009.69	1.381	0.0014346	18.202	9.904	1110.12	1.381	0.0007201	10.045	9.008
1011.33	1.381	0.0014675	18.650	9.888	1112.10	1.381	0.0007388	10.324	8.992
1012.97	1.381	0.0015444	19.659	9.872	1114.08	1.381	0.0007579	10.610	8.976
1014.61	1.381	0.0018279	23.306	9.856	1116.07	1.381	0.0007774	10.903	8.960
1016.26	1.381	0.0021740	27.763	9.840	1118.07	1.381	0.0008132	11.426	8.944
1017.92	1.380	0.0021376	27.343	9.824	1120.07	1.381	0.0009761	13.739	8.928
1019.58	1.380	0.0019088	24.457	9.808	1122.08	1.381	0.0011775	16.603	8.912
1021.24	1.380	0.0018322	23.513	9.792	1124.10	1.381	0.0013905	19.642	8.896
1022.91	1.380	0.0017679	22.726	9.776	1128.16	1.382	0.0015210	21.562	8.864
1024.59	1.380	0.0016459	21.191	9.760	1130.20	1.382	0.0018725	26.594	8.848
1026.27	1.380	0.0014333	18.485	9.744	1132.25	1.382	0.0022209	31.599	8.832
1027.96	1.380	0.0012681	16.381	9.728	1134.30	1.381	0.0025894	36.909	8.816
1029.65	1.380	0.0012296	15.909	9.712	1136.36	1.381	0.0025999	37.126	8.800
1031.35	1.380	0.0012122	15.710	9.696	1138.43	1.380	0.0025877	37.019	8.784
1033.06	1.380	0.0011613	15.076	9.680	1140.51	1.380	0.0024709	35.413	8.768
1034.77	1.380	0.0011238	14.613	9.664	1142.60	1.380	0.0021656	31.094	8.752
1036.48	1.380	0.0011406	14.856	9.648	1144.69	1.380	0.0018643	26.817	8.736
1038.21	1.381	0.0012407	16.187	9.632	1146.79	1.380	0.0014413	20.770	8.720
1039.93	1.381	0.0013911	18.180	9.616	1148.90	1.380	0.0013377	19.313	8.704
1041.67	1.381	0.0014867	19.461	9.600	1151.01	1.380	0.0012465	18.029	8.688
1043.41	1.381	0.0014533	19.055	9.584	1153.14	1.380	0.0011748	17.023	8.672
1045.15	1.381	0.0014566	19.131	9.568	1155.27	1.380	0.0011978	17.389	8.656
1046.90	1.381	0.0015487	20.375	9.552	1157.41	1.380	0.0012452	18.111	8.640
1048.66	1.381	0.0016424	21.643	9.536	1159.56	1.380	0.0011800	17.194	8.624
1050.42	1.381	0.0015896	20.983	9.520	1161.71	1.380	0.0011457	16.726	8.608
1052.19	1.381	0.0015571	20.589	9.504	1163.87	1.380	0.0010617	15.528	8.592
1053.96	1.381	0.0016377	21.690	9.488	1166.05	1.380	0.0009148	13.404	8.576
1055.74	1.381	0.0018739	24.860	9.472	1168.22	1.380	0.0007657	11.241	8.560
1057.53	1.381	0.0021797	28.966	9.456	1170.41	1.381	0.0006859	10.088	8.544
1059.32	1.381	0.0021936	29.201	9.440	1172.61	1.381	0.0006524	9.614	8.528
1061.12	1.381	0.0023224	30.968	9.424	1174.81	1.381	0.0006463	9.541	8.512
1062.93	1.381	0.0026275	35.096	9.408	1177.02	1.381	0.0006290	9.304	8.496
1064.74	1.381	0.0030934	41.389	9.392	1179.25	1.381	0.0006057	8.975	8.480
1066.55	1.380	0.0032479	43.530	9.376	1181.47	1.381	0.0006048	8.980	8.464
1068.38	1.380	0.0031822	42.724	9.360	1183.71	1.381	0.0006443	9.584	8.448
1070.21	1.379	0.0029926	40.246	9.344	1185.96	1.381	0.0006992	10.420	8.432
1072.04	1.379	0.0028292	38.114	9.328	1188.21	1.381	0.0007554	11.279	8.416
1073.88	1.379	0.0024092	32.512	9.312	1190.48	1.382	0.0008343	12.480	8.400
1075.73	1.379	0.0021247	28.722	9.296	1192.75	1.382	0.0009452	14.167	8.384
1077.59	1.379	0.0017328	23.464	9.280	1195.03	1.382	0.0011275	16.932	8.368
1079.45	1.379	0.0010876	14.754	9.264	1197.32	1.381	0.0011621	17.484	8.352
1081.32	1.379	0.0010367	14.087	9.248	1199.62	1.381	0.0008980	13.538	8.336
1083.19	1.379	0.0007931	10.796	9.232	1201.92	1.381	0.0007819	11.810	8.320
1085.07	1.380	0.0008509	11.603	9.216	1204.24	1.382	0.0006976	10.556	8.304
1086.96	1.380	0.0011454	15.645	9.200	1206.56	1.382	0.0006663	10.102	8.288
1088.85	1.380	0.0009120	12.479	9.184	1208.90	1.382	0.0005838	8.868	8.272
1090.75	1.380	0.0008631	11.830	9.168	1211.24	1.382	0.0007748	11.793	8.256
1092.66	1.380	0.0008160	11.204	9.152	1213.59	1.382	0.0010584	16.141	8.240
1094.57	1.380	0.0007303	10.045	9.136	1215.95	1.382	0.0012712	19.424	8.224
1096.49	1.380	0.0006710	9.246	9.120	1218.32	1.382	0.0014192	21.729	8.208
1098.42	1.380	0.0006514	8.992	9.104	1220.70	1.382	0.0014128	21.672	8.192
1100.35	1.380	0.0006323	8.743	9.088	1223.09	1.382	0.0011063	17.004	8.176
1102.29	1.380	0.0006491	8.992	9.072	1225.49	1.382	0.0009222	14.202	8.160

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1227.90	1.382	0.0010707	16.522	8.144	1379.69	1.377	0.0105991	183.764	7.248
1230.32	1.382	0.0010706	16.552	8.128	1382.74	1.377	0.0072928	126.721	7.232
1232.74	1.383	0.0011645	18.040	8.112	1385.81	1.379	0.0050184	87.394	7.216
1235.18	1.383	0.0014183	22.014	8.096	1388.89	1.380	0.0036863	64.339	7.200
1237.62	1.382	0.0014763	22.960	8.080	1391.98	1.382	0.0028285	49.476	7.184
1240.08	1.382	0.0015243	23.753	8.064	1395.09	1.383	0.0023413	41.046	7.168
1242.55	1.382	0.0015300	23.890	8.048	1398.21	1.385	0.0022517	39.563	7.152
1245.02	1.382	0.0012566	19.661	8.032	1401.35	1.386	0.0024782	43.641	7.136
1247.51	1.382	0.0009083	14.240	8.016	1404.49	1.388	0.0028269	49.894	7.120
1250.00	1.383	0.0007907	12.420	8.000	1407.66	1.389	0.0033425	59.126	7.104
1252.51	1.383	0.0006292	9.904	7.984	1410.84	1.390	0.0040410	71.644	7.088
1255.02	1.383	0.0005385	8.492	7.968	1414.03	1.391	0.0049531	88.012	7.072
1257.55	1.384	0.0008807	13.918	7.952	1417.23	1.392	0.0058153	103.567	7.056
1260.08	1.384	0.0013463	21.318	7.936	1420.46	1.394	0.0065180	116.346	7.040
1262.63	1.384	0.0017400	27.607	7.920	1423.69	1.397	0.0070221	125.630	7.024
1265.18	1.384	0.0022320	35.486	7.904	1426.94	1.399	0.0129002	231.320	7.008
1267.75	1.384	0.0025603	40.787	7.888	1430.21	1.398	0.0147846	265.718	6.992
1270.33	1.384	0.0027726	44.261	7.872	1433.49	1.399	0.0181031	326.105	6.976
1272.91	1.383	0.0026467	42.336	7.856	1436.78	1.399	0.0206281	372.442	6.960
1275.51	1.383	0.0023560	37.763	7.840	1440.09	1.399	0.0244107	441.754	6.944
1278.12	1.383	0.0020709	33.261	7.824	1443.42	1.399	0.0294199	533.634	6.928
1280.74	1.383	0.0015806	25.439	7.808	1446.76	1.397	0.0346696	630.311	6.912
1283.37	1.384	0.0016617	26.800	7.792	1450.12	1.393	0.0413456	753.430	6.896
1286.01	1.384	0.0020518	33.158	7.776	1453.49	1.385	0.0480419	877.491	6.880
1288.66	1.385	0.0026843	43.469	7.760	1456.88	1.375	0.0493277	903.076	6.864
1291.32	1.384	0.0030989	50.287	7.744	1460.28	1.364	0.0480729	882.158	6.848
1294.00	1.384	0.0034599	56.261	7.728	1463.70	1.353	0.0416025	765.212	6.832
1296.68	1.384	0.0036184	58.960	7.712	1467.14	1.347	0.0307893	567.652	6.816
1299.38	1.383	0.0031357	51.201	7.696	1470.59	1.347	0.0209971	388.027	6.800
1302.08	1.383	0.0026168	42.818	7.680	1474.06	1.350	0.0145792	270.059	6.784
1304.80	1.383	0.0023617	38.724	7.664	1477.54	1.351	0.0116196	215.745	6.768
1307.53	1.384	0.0021417	35.191	7.648	1481.04	1.354	0.0059042	109.885	6.752
1310.27	1.384	0.0019760	32.536	7.632	1484.56	1.358	0.0043583	81.307	6.736
1313.03	1.385	0.0023543	38.846	7.616	1488.10	1.360	0.0036922	69.045	6.720
1315.79	1.385	0.0028011	46.316	7.600	1491.65	1.362	0.0032905	61.678	6.704
1318.57	1.385	0.0031368	51.975	7.584	1495.22	1.363	0.0032083	60.282	6.688
1321.35	1.385	0.0033579	55.756	7.568	1498.80	1.364	0.0027143	51.122	6.672
1324.15	1.385	0.0034847	57.984	7.552	1502.40	1.365	0.0022259	42.025	6.656
1326.96	1.385	0.0034972	58.316	7.536	1506.02	1.366	0.0016213	30.684	6.640
1329.79	1.385	0.0035718	59.687	7.520	1520.68	1.369	0.0015175	28.999	6.576
1332.62	1.385	0.0036443	61.028	7.504	1524.39	1.369	0.0014804	28.359	6.560
1335.47	1.385	0.0035329	59.290	7.488	1539.41	1.371	0.0011019	21.317	6.496
1338.33	1.384	0.0031478	52.940	7.472	1547.03	1.371	0.0009687	18.831	6.464
1341.20	1.385	0.0025394	42.800	7.456	1550.87	1.372	0.0008557	16.676	6.448
1344.09	1.386	0.0021740	36.720	7.440	1554.73	1.372	0.0008460	16.528	6.432
1346.98	1.386	0.0021703	36.735	7.424	1558.60	1.372	0.0007493	14.677	6.416
1349.89	1.387	0.0024764	42.007	7.408	1562.50	1.372	0.0007412	14.554	6.400
1352.81	1.388	0.0029296	49.804	7.392	1566.42	1.373	0.0007397	14.561	6.384
1355.75	1.389	0.0036926	62.911	7.376	1570.35	1.373	0.0006606	13.037	6.368
1358.70	1.390	0.0046132	78.766	7.360	1574.31	1.373	0.0006520	12.900	6.352
1361.66	1.391	0.0060028	102.714	7.344	1578.28	1.373	0.0006365	12.624	6.336
1364.63	1.392	0.0084240	144.459	7.328	1582.28	1.373	0.0006073	12.076	6.320
1367.62	1.392	0.0113068	194.320	7.312	1586.29	1.373	0.0005985	11.930	6.304
1370.61	1.390	0.0162208	279.380	7.296	1590.33	1.374	0.0005813	11.617	6.288
1373.63	1.384	0.0185650	320.461	7.280	1594.39	1.374	0.0005477	10.973	6.272
1376.65	1.379	0.0144116	249.314	7.264	1602.56	1.374	0.0005309	10.692	6.240

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frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1606.68	1.374	0.0005052	10.200	6.224	1893.94	1.378	0.0001313	3.125	5.280
1610.83	1.374	0.0004743	9.601	6.208	1896.81	1.378	0.0001248	2.974	5.272
1614.99	1.374	0.0004687	9.511	6.192	1899.70	1.378	0.0001162	2.774	5.264
1619.17	1.374	0.0004485	9.125	6.176	1902.59	1.378	0.0001027	2.456	5.256
1623.38	1.375	0.0004133	8.431	6.160	1905.49	1.378	0.0000961	2.302	5.248
1631.85	1.375	0.0004104	8.416	6.128	1908.40	1.378	0.0000917	2.198	5.240
1640.42	1.375	0.0004045	8.339	6.096	1911.32	1.378	0.0000879	2.111	5.232
1644.74	1.375	0.0004092	8.457	6.080	1914.24	1.378	0.0000864	2.079	5.224
1653.44	1.375	0.0004020	8.353	6.048	1917.18	1.378	0.0000885	2.133	5.216
1662.23	1.375	0.0003977	8.308	6.016	1920.12	1.378	0.0000936	2.258	5.208
1666.67	1.375	0.0003925	8.221	6.000	1923.08	1.378	0.0000940	2.271	5.200
1671.12	1.376	0.0003887	8.163	5.984	1926.04	1.378	0.0001000	2.420	5.192
1680.11	1.376	0.0003751	7.919	5.952	1929.01	1.378	0.0001016	2.462	5.184
1684.64	1.376	0.0003670	7.768	5.936	1931.99	1.378	0.0000984	2.390	5.176
1693.77	1.376	0.0003569	7.597	5.904	1934.99	1.378	0.0001057	2.570	5.168
1698.37	1.376	0.0003033	6.473	5.888	1937.98	1.378	0.0001022	2.490	5.160
1703.00	1.376	0.0002852	6.104	5.872	1940.99	1.378	0.0001009	2.462	5.152
1707.65	1.376	0.0002569	5.513	5.856	1944.01	1.378	0.0001006	2.459	5.144
1712.33	1.376	0.0002329	5.011	5.840	1947.04	1.378	0.0000921	2.254	5.136
1717.03	1.376	0.0002201	4.750	5.824	1950.08	1.378	0.0000862	2.113	5.128
1726.52	1.376	0.0002038	4.423	5.792	1953.13	1.378	0.0000836	2.052	5.120
1750.70	1.377	0.0001957	4.305	5.712	1956.18	1.378	0.0000764	1.879	5.112
1755.62	1.377	0.0001881	4.151	5.696	1959.25	1.378	0.0000771	1.897	5.104
1760.56	1.377	0.0001937	4.285	5.680	1962.32	1.378	0.0000748	1.845	5.096
1765.54	1.377	0.0001668	3.701	5.664	1965.41	1.378	0.0000737	1.820	5.088
1770.54	1.377	0.0001674	3.724	5.648	1968.50	1.378	0.0000727	1.799	5.080
1775.57	1.377	0.0001489	3.323	5.632	1971.61	1.378	0.0000755	1.870	5.072
1780.63	1.377	0.0001420	3.177	5.616	1974.72	1.378	0.0000761	1.889	5.064
1785.71	1.377	0.0001289	2.893	5.600	1977.85	1.378	0.0000784	1.950	5.056
1790.83	1.377	0.0001358	3.057	5.584	1980.98	1.378	0.0000830	2.066	5.048
1795.98	1.377	0.0001283	2.895	5.568	1984.13	1.378	0.0000814	2.030	5.040
1801.15	1.377	0.0001059	2.398	5.552	1987.28	1.378	0.0000852	2.128	5.032
1806.36	1.377	0.0000958	2.175	5.536	1990.45	1.378	0.0000844	2.112	5.024
1811.59	1.377	0.0000899	2.048	5.520	1993.62	1.378	0.0000900	2.255	5.016
1816.86	1.377	0.0000790	1.805	5.504	1996.81	1.378	0.0000974	2.444	5.008
1822.16	1.377	0.0000735	1.684	5.488	2000.00	1.378	0.0001070	2.689	5.000
1827.49	1.377	0.0000707	1.623	5.472	2003.21	1.378	0.0001229	3.093	4.992
1832.85	1.377	0.0000820	1.888	5.456	2006.42	1.379	0.0001438	3.625	4.984
1838.24	1.377	0.0000960	2.218	5.440	2009.65	1.379	0.0001601	4.042	4.976
1843.66	1.377	0.0000963	2.231	5.424	2012.88	1.379	0.0001848	4.674	4.968
1849.11	1.377	0.0001116	2.593	5.408	2016.13	1.379	0.0002006	5.083	4.960
1851.85	1.377	0.0000933	2.171	5.400	2019.39	1.379	0.0002175	5.520	4.952
1854.60	1.377	0.0000999	2.328	5.392	2022.65	1.379	0.0002291	5.822	4.944
1857.36	1.378	0.0001073	2.505	5.384	2025.93	1.379	0.0002339	5.954	4.936
1860.12	1.378	0.0001101	2.573	5.376	2029.22	1.379	0.0002321	5.918	4.928
1862.89	1.378	0.0001124	2.631	5.368	2032.52	1.379	0.0002274	5.808	4.920
1865.67	1.378	0.0001161	2.723	5.360	2035.83	1.379	0.0002131	5.451	4.912
1868.46	1.378	0.0001195	2.806	5.352	2039.15	1.379	0.0002050	5.253	4.904
1871.26	1.378	0.0001253	2.945	5.344	2042.48	1.379	0.0001853	4.756	4.896
1874.06	1.378	0.0001344	3.165	5.336	2045.83	1.379	0.0001714	4.408	4.888
1876.88	1.378	0.0001487	3.506	5.328	2049.18	1.379	0.0001590	4.094	4.880
1879.70	1.378	0.0001528	3.609	5.320	2052.55	1.379	0.0001430	3.689	4.872
1882.53	1.378	0.0001563	3.697	5.312	2055.92	1.379	0.0001382	3.571	4.864
1885.37	1.378	0.0001597	3.782	5.304	2059.31	1.379	0.0001301	3.366	4.856
1888.22	1.378	0.0001511	3.586	5.296	2062.71	1.379	0.0001220	3.163	4.848
1891.07	1.378	0.0001430	3.397	5.288	2066.12	1.379	0.0001201	3.117	4.840

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2079.87	1.379	0.0001177	3.077	4.808	2293.58	1.380	0.0002903	8.366	4.360
2083.33	1.379	0.0001136	2.975	4.800	2297.79	1.380	0.0002998	8.656	4.352
2086.81	1.379	0.0001126	2.953	4.792	2302.03	1.380	0.0003111	8.998	4.344
2090.30	1.379	0.0001134	2.980	4.784	2306.27	1.380	0.0003194	9.257	4.336
2093.80	1.379	0.0001101	2.898	4.776	2310.54	1.380	0.0003319	9.637	4.328
2097.32	1.379	0.0001131	2.981	4.768	2314.82	1.380	0.0003358	9.768	4.320
2100.84	1.379	0.0001110	2.930	4.760	2319.11	1.380	0.0003418	9.961	4.312
2104.38	1.379	0.0001111	2.938	4.752	2323.42	1.380	0.0003453	10.080	4.304
2107.93	1.379	0.0001118	2.962	4.744	2327.75	1.380	0.0003438	10.056	4.296
2111.49	1.379	0.0001149	3.048	4.736	2332.09	1.380	0.0003363	9.856	4.288
2115.06	1.379	0.0001200	3.191	4.728	2336.45	1.380	0.0003275	9.617	4.280
2118.64	1.379	0.0001262	3.359	4.720	2340.82	1.380	0.0003285	9.663	4.272
2122.24	1.379	0.0001348	3.594	4.712	2345.22	1.380	0.0003286	9.685	4.264
2125.85	1.379	0.0001415	3.781	4.704	2349.62	1.381	0.0003242	9.571	4.256
2129.47	1.379	0.0001510	4.040	4.696	2354.05	1.381	0.0003383	10.007	4.248
2133.11	1.379	0.0001676	4.494	4.688	2358.49	1.381	0.0003375	10.002	4.240
2136.75	1.379	0.0001815	4.875	4.680	2362.95	1.381	0.0003472	10.311	4.232
2140.41	1.379	0.0001949	5.242	4.672	2367.42	1.381	0.0003623	10.778	4.224
2144.08	1.379	0.0002055	5.537	4.664	2371.92	1.381	0.0003730	11.119	4.216
2147.77	1.379	0.0002151	5.807	4.656	2376.43	1.381	0.0003686	11.009	4.208
2151.46	1.379	0.0002135	5.772	4.648	2380.95	1.381	0.0003687	11.031	4.200
2155.17	1.379	0.0002161	5.852	4.640	2385.50	1.381	0.0003688	11.055	4.192
2158.90	1.379	0.0002178	5.908	4.632	2390.06	1.381	0.0003646	10.951	4.184
2162.63	1.379	0.0002150	5.842	4.624	2394.64	1.381	0.0003450	10.383	4.176
2166.38	1.379	0.0002148	5.849	4.616	2399.23	1.381	0.0003277	9.879	4.168
2170.14	1.379	0.0002083	5.680	4.608	2403.85	1.381	0.0003072	9.281	4.160
2173.91	1.379	0.0002095	5.722	4.600	2408.48	1.381	0.0002855	8.640	4.152
2177.70	1.379	0.0002076	5.680	4.592	2413.13	1.381	0.0002678	8.121	4.144
2181.50	1.379	0.0002105	5.770	4.584	2417.80	1.381	0.0002495	7.581	4.136
2185.32	1.379	0.0002093	5.747	4.576	2422.48	1.381	0.0002357	7.176	4.128
2189.14	1.379	0.0002087	5.741	4.568	2427.18	1.381	0.0002238	6.826	4.120
2192.98	1.379	0.0002134	5.882	4.560	2431.91	1.381	0.0002141	6.543	4.112
2196.84	1.380	0.0002144	5.919	4.552	2436.65	1.381	0.0002074	6.351	4.104
2200.70	1.380	0.0002244	6.205	4.544	2441.41	1.381	0.0002002	6.142	4.096
2204.59	1.380	0.0002284	6.329	4.536	2446.18	1.381	0.0001965	6.041	4.088
2208.48	1.380	0.0002332	6.473	4.528	2450.98	1.381	0.0001958	6.031	4.080
2212.39	1.380	0.0002348	6.528	4.520	2455.80	1.382	0.0001953	6.028	4.072
2216.31	1.380	0.0002347	6.537	4.512	2460.63	1.382	0.0001952	6.036	4.064
2220.25	1.380	0.0002341	6.532	4.504	2465.48	1.382	0.0001987	6.156	4.056
2224.20	1.380	0.0002288	6.395	4.496	2470.36	1.382	0.0002031	6.305	4.048
2228.16	1.380	0.0002248	6.294	4.488	2475.25	1.382	0.0002103	6.542	4.040
2232.14	1.380	0.0002151	6.034	4.480	2480.16	1.382	0.0002180	6.793	4.032
2236.14	1.380	0.0002125	5.971	4.472	2485.09	1.382	0.0002260	7.058	4.024
2240.14	1.380	0.0002053	5.780	4.464	2490.04	1.382	0.0002404	7.521	4.016
2244.17	1.380	0.0002076	5.856	4.456	2495.01	1.382	0.0002555	8.009	4.008
2248.20	1.380	0.0002074	5.860	4.448	2500.00	1.382	0.0002743	8.618	4.000
2252.25	1.380	0.0002070	5.859	4.440	2505.01	1.382	0.0003188	10.034	3.992
2256.32	1.380	0.0002140	6.067	4.432	2510.04	1.382	0.0003190	10.061	3.984
2260.40	1.380	0.0002203	6.258	4.424	2515.09	1.383	0.0003230	10.210	3.976
2264.49	1.380	0.0002288	6.511	4.416	2520.16	1.383	0.0003355	10.626	3.968
2268.60	1.380	0.0002383	6.793	4.408	2525.25	1.383	0.0003441	10.919	3.960
2272.73	1.380	0.0002466	7.044	4.400	2530.36	1.383	0.0003533	11.235	3.952
2276.87	1.380	0.0002555	7.309	4.392	2535.50	1.383	0.0003623	11.544	3.944
2281.02	1.380	0.0002633	7.548	4.384	2540.65	1.383	0.0003787	12.090	3.936
2285.19	1.380	0.0002748	7.890	4.376	2545.83	1.383	0.0004015	12.845	3.928
2289.38	1.380	0.0002844	8.183	4.368	2551.02	1.383	0.0004319	13.847	3.920

HEPTANE					HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2556.24	1.383	0.0004734	15.207	3.912	2927.40	1.360	0.0632995	2328.584	3.416
2561.48	1.384	0.0005322	17.130	3.904	2934.27	1.347	0.0553506	2040.950	3.408
2566.74	1.384	0.0005895	19.015	3.896	2941.18	1.340	0.0438177	1619.500	3.400
2572.02	1.384	0.0006592	21.307	3.888	2948.11	1.338	0.0341301	1264.419	3.392
2577.32	1.384	0.0007261	23.518	3.880	2955.08	1.338	0.0265285	985.127	3.384
2582.65	1.384	0.0007926	25.722	3.872	2962.09	1.339	0.0203270	756.626	3.376
2587.99	1.384	0.0008438	27.441	3.864	2969.12	1.341	0.0142096	530.175	3.368
2593.36	1.384	0.0008825	28.760	3.856	2976.19	1.344	0.0090495	338.452	3.360
2598.75	1.384	0.0009239	30.171	3.848	2983.29	1.348	0.0060432	226.556	3.352
2604.17	1.384	0.0009473	31.000	3.840	2990.43	1.352	0.0048758	183.228	3.344
2609.60	1.384	0.0009747	31.963	3.832	2997.60	1.355	0.0040683	153.250	3.336
2615.06	1.384	0.0009996	32.849	3.824	3071.25	1.365	0.0039025	150.616	3.256
2620.55	1.385	0.0010048	33.089	3.816	3078.82	1.365	0.0038109	147.444	3.248
2626.05	1.385	0.0010415	34.368	3.808	3086.42	1.366	0.0037401	145.060	3.240
2631.58	1.385	0.0010671	35.288	3.800	3094.06	1.366	0.0036927	143.577	3.232
2648.31	1.385	0.0010902	36.281	3.776	3101.74	1.366	0.0036598	142.649	3.224
2653.93	1.385	0.0011027	36.776	3.768	3109.45	1.366	0.0036386	142.176	3.216
2659.57	1.386	0.0010759	35.956	3.760	3117.21	1.366	0.0036175	141.705	3.208
2688.17	1.387	0.0010692	36.116	3.720	3125.00	1.366	0.0036077	141.674	3.200
2693.97	1.387	0.0011151	37.751	3.712	3132.83	1.366	0.0020857	82.111	3.192
2699.78	1.387	0.0011485	38.965	3.704	3140.70	1.367	0.0020680	81.618	3.184
2705.63	1.388	0.0011831	40.225	3.696	3148.62	1.367	0.0020680	81.826	3.176
2711.50	1.388	0.0012417	42.309	3.688	3156.57	1.368	0.0020588	81.667	3.168
2717.39	1.389	0.0013441	45.899	3.680	3164.56	1.368	0.0020392	81.091	3.160
2723.31	1.389	0.0014187	48.551	3.672	3172.59	1.368	0.0020110	80.173	3.152
2729.26	1.389	0.0014950	51.275	3.664	3180.66	1.368	0.0019768	79.010	3.144
2735.23	1.390	0.0015348	52.753	3.656	3188.78	1.367	0.0019242	77.106	3.136
2741.23	1.390	0.0015281	52.639	3.648	3196.93	1.367	0.0003639	14.618	3.128
2747.25	1.391	0.0015311	52.858	3.640	3205.13	1.368	0.0002970	11.960	3.120
2753.30	1.391	0.0015310	52.971	3.632	3213.37	1.369	0.0002395	9.672	3.112
2759.38	1.392	0.0016113	55.871	3.624	3221.65	1.369	0.0001908	7.726	3.104
2765.49	1.393	0.0017347	60.284	3.616	3246.75	1.370	0.0001726	7.043	3.080
2771.62	1.394	0.0019870	69.207	3.608	3255.21	1.370	0.0001558	6.374	3.072
2777.78	1.395	0.0023230	81.089	3.600	3263.71	1.370	0.0001410	5.782	3.064
2783.96	1.396	0.0029683	103.845	3.592	3272.25	1.371	0.0001290	5.305	3.056
2790.18	1.397	0.0032393	113.577	3.584	3280.84	1.371	0.0001225	5.052	3.048
2796.42	1.399	0.0037394	131.407	3.576	3289.47	1.371	0.0001161	4.797	3.040
2802.69	1.400	0.0044068	155.206	3.568	3298.15	1.371	0.0001123	4.656	3.032
2808.99	1.403	0.0050833	179.436	3.560	3306.88	1.371	0.0001114	4.629	3.024
2815.32	1.405	0.0066693	235.950	3.552	3315.65	1.371	0.0001115	4.645	3.016
2821.67	1.408	0.0094662	335.654	3.544	3324.47	1.372	0.0001143	4.775	3.008
2828.05	1.411	0.0130249	462.883	3.536	3333.33	1.372	0.0001153	4.831	3.000
2834.47	1.412	0.0193230	688.267	3.528	3342.25	1.372	0.0001172	4.924	2.992
2840.91	1.412	0.0235191	839.631	3.520	3351.21	1.372	0.0001166	4.910	2.984
2847.38	1.411	0.0290282	1038.663	3.512	3360.22	1.372	0.0001159	4.892	2.976
2853.88	1.408	0.0334943	1201.203	3.504	3369.27	1.372	0.0001127	4.772	2.968
2860.41	1.404	0.0366468	1317.268	3.496	3378.38	1.372	0.0001092	4.634	2.960
2866.97	1.400	0.0386010	1390.693	3.488	3387.53	1.372	0.0001038	4.420	2.952
2873.56	1.396	0.0398765	1439.949	3.480	3396.74	1.373	0.0000962	4.108	2.944
2880.18	1.394	0.0378746	1370.812	3.472	3406.00	1.373	0.0000898	3.845	2.936
2886.84	1.394	0.0385780	1399.498	3.464	3415.30	1.373	0.0000824	3.535	2.928
2893.52	1.395	0.0417173	1516.883	3.456	3424.66	1.373	0.0000754	3.243	2.920
2900.23	1.394	0.0464242	1691.948	3.448	3434.07	1.373	0.0000674	2.907	2.912
2906.98	1.391	0.0520679	1902.050	3.440	3443.53	1.373	0.0000592	2.561	2.904
2913.75	1.385	0.0588685	2155.487	3.432	3453.04	1.373	0.0000519	2.253	2.896
2920.56	1.374	0.0640455	2350.522	3.424	3462.60	1.373	0.0000457	1.988	2.888

HEPTANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3472.22	1.373	0.0000414	1.804	2.880
3481.89	1.373	0.0000371	1.625	2.872
3491.62	1.373	0.0000350	1.537	2.864
3501.40	1.374	0.0000320	1.410	2.856
3511.24	1.374	0.0000343	1.514	2.848
3521.13	1.374	0.0000375	1.660	2.840
3531.07	1.374	0.0000430	1.908	2.832
3541.08	1.374	0.0000510	2.270	2.824
3551.14	1.374	0.0000613	2.734	2.816
3561.25	1.374	0.0000749	3.351	2.808
3571.43	1.374	0.0000938	4.208	2.800
3581.66	1.374	0.0001105	4.974	2.792
3591.95	1.374	0.0001272	5.741	2.784
3602.31	1.374	0.0001439	6.513	2.776
3612.72	1.374	0.0001562	7.092	2.768
3623.19	1.374	0.0001642	7.476	2.760
3633.72	1.374	0.0001664	7.600	2.752
3644.32	1.374	0.0001685	7.716	2.744
3654.97	1.374	0.0001676	7.700	2.736
3665.69	1.374	0.0001658	7.636	2.728
3676.47	1.375	0.0001633	7.542	2.720
3687.32	1.375	0.0001620	7.505	2.712
3698.23	1.375	0.0001602	7.445	2.704
3709.20	1.375	0.0001610	7.506	2.696
3720.24	1.375	0.0001632	7.630	2.688
3731.34	1.375	0.0001664	7.803	2.680
3742.52	1.375	0.0001683	7.914	2.672
3753.75	1.375	0.0001736	8.190	2.664
3765.06	1.375	0.0001805	8.539	2.656
3776.44	1.375	0.0001802	8.552	2.648
3787.88	1.375	0.0001812	8.623	2.640
3799.39	1.375	0.0001824	8.708	2.632
3810.98	1.375	0.0001844	8.831	2.624
3822.63	1.375	0.0001828	8.782	2.616
3834.36	1.375	0.0001852	8.925	2.608
3846.15	1.375	0.0001865	9.013	2.600
3858.03	1.375	0.0001884	9.132	2.592
3869.97	1.375	0.0001861	9.048	2.584
3881.99	1.375	0.0001944	9.485	2.576
3894.08	1.375	0.0001955	9.569	2.568
3906.25	1.375	0.0001937	9.507	2.560
4000.00	1.376	0.0003959	19.900	2.500
4100.00	1.376	0.0004386	22.600	2.439
4200.00	1.376	0.0005551	29.300	2.381
4300.00	1.376	0.0006662	36.000	2.326
4400.00	1.376	0.0005607	31.000	2.273
4500.00	1.376	0.0004598	26.000	2.222
4600.00	1.376	0.0003633	21.000	2.174
4700.00	1.376	0.0002709	16.000	2.128
4800.00	1.376	0.0001658	10.000	2.083
4900.00	1.376	0.0000974	6.000	2.041
5000.00	1.376	0.0000286	1.800	2.000

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
667.00	1.401	0.0005071	4.250	14.993	776.40	1.393	0.0034493	33.653	12.880
678.00	1.403	0.0006033	5.140	14.749	779.30	1.393	0.0029430	28.821	12.832
691.00	1.405	0.0014764	12.820	14.472	781.25	1.393	0.0028499	27.979	12.800
702.00	1.408	0.0033282	29.360	14.245	783.21	1.393	0.0026151	25.738	12.768
707.00	1.409	0.0059272	52.660	14.144	784.19	1.393	0.0023177	22.840	12.752
713.00	1.411	0.0103239	92.500	14.025	786.16	1.393	0.0022801	22.526	12.720
714.29	1.412	0.0110644	99.314	14.000	787.15	1.393	0.0019243	19.034	12.704
715.10	1.413	0.0142774	128.300	13.984	789.14	1.393	0.0018449	18.295	12.672
716.74	1.412	0.0145473	131.025	13.952	790.14	1.394	0.0015335	15.226	12.656
717.57	1.415	0.0168008	151.497	13.936	791.14	1.394	0.0015321	15.232	12.640
718.39	1.415	0.0237002	213.955	13.920	792.14	1.394	0.0014916	14.848	12.624
719.22	1.409	0.0276853	250.219	13.904	793.15	1.394	0.0012591	12.549	12.608
720.88	1.401	0.0258036	233.751	13.872	794.16	1.394	0.0011994	11.970	12.592
722.54	1.395	0.0251213	228.094	13.840	795.17	1.394	0.0011626	11.617	12.576
723.38	1.393	0.0207316	188.456	13.824	796.18	1.394	0.0009999	10.004	12.560
725.06	1.392	0.0191310	174.310	13.792	797.19	1.394	0.0009268	9.284	12.544
725.90	1.391	0.0168502	153.706	13.776	798.21	1.395	0.0009181	9.209	12.528
726.74	1.391	0.0152322	139.108	13.760	799.23	1.395	0.0008472	8.509	12.512
727.59	1.392	0.0146993	134.398	13.744	802.31	1.395	0.0008184	8.251	12.464
729.29	1.391	0.0144792	132.695	13.712	804.38	1.395	0.0008212	8.301	12.432
730.14	1.391	0.0131083	120.271	13.696	806.45	1.396	0.0008307	8.418	12.400
731.85	1.391	0.0128198	117.900	13.664	807.49	1.396	0.0008281	8.403	12.384
732.71	1.391	0.0127060	116.991	13.648	808.54	1.396	0.0009150	9.297	12.368
733.57	1.390	0.0115246	106.237	13.632	810.64	1.396	0.0009329	9.503	12.336
734.43	1.391	0.0110268	101.768	13.616	811.69	1.396	0.0010250	10.455	12.320
736.16	1.390	0.0106681	98.689	13.584	813.80	1.396	0.0010383	10.618	12.288
737.03	1.390	0.0092053	85.258	13.568	814.86	1.396	0.0011760	12.042	12.272
737.90	1.390	0.0092574	85.841	13.552	815.93	1.396	0.0011878	12.179	12.256
738.77	1.390	0.0092747	86.103	13.536	816.99	1.396	0.0011972	12.291	12.240
739.64	1.389	0.0082734	76.898	13.520	818.06	1.396	0.0013444	13.821	12.224
740.52	1.389	0.0069218	64.412	13.504	819.13	1.396	0.0014263	14.682	12.208
742.28	1.390	0.0062564	58.358	13.472	820.21	1.397	0.0014194	14.630	12.192
744.05	1.391	0.0055209	51.620	13.440	821.29	1.397	0.0015333	15.825	12.176
746.71	1.392	0.0052375	49.146	13.392	822.37	1.397	0.0016853	17.416	12.160
747.61	1.392	0.0049717	46.708	13.376	823.45	1.397	0.0016694	17.275	12.144
748.50	1.392	0.0046712	43.937	13.360	824.54	1.397	0.0018218	18.877	12.128
749.40	1.392	0.0041266	38.861	13.344	825.63	1.397	0.0019617	20.353	12.112
750.30	1.393	0.0045015	42.443	13.328	826.72	1.396	0.0018808	19.539	12.096
751.20	1.393	0.0046971	44.340	13.312	827.81	1.396	0.0018444	19.186	12.080
752.11	1.393	0.0042006	39.701	13.296	828.91	1.396	0.0019872	20.699	12.064
753.01	1.394	0.0045974	43.503	13.280	830.01	1.396	0.0019871	20.726	12.048
753.92	1.394	0.0050213	47.572	13.264	831.12	1.396	0.0018067	18.869	12.032
759.42	1.393	0.0047537	45.365	13.168	832.22	1.396	0.0017681	18.491	12.016
761.27	1.393	0.0044762	42.821	13.136	833.33	1.396	0.0018068	18.921	12.000
762.20	1.393	0.0044685	42.800	13.120	834.45	1.396	0.0017760	18.623	11.984
763.13	1.393	0.0038611	37.027	13.104	835.56	1.396	0.0017217	18.078	11.968
764.99	1.393	0.0038650	37.155	13.072	836.68	1.396	0.0017889	18.809	11.952
766.87	1.393	0.0035663	34.368	13.040	837.80	1.396	0.0018343	19.312	11.936
770.65	1.394	0.0036007	34.870	12.976	838.93	1.396	0.0017871	18.840	11.920
772.56	1.394	0.0039502	38.350	12.944	840.05	1.397	0.0018641	19.678	11.904
773.51	1.394	0.0039068	37.975	12.928	841.18	1.396	0.0019650	20.771	11.888
774.47	1.394	0.0054737	53.272	12.912	842.32	1.396	0.0019519	20.661	11.872
775.43	1.392	0.0040319	39.288	12.896	843.45	1.396	0.0018224	19.316	11.856
					844.59	1.396	0.0019369	20.557	11.840
					845.74	1.396	0.0018338	19.489	11.824
					846.88	1.396	0.0016637	17.705	11.808

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
848.03	1.396	0.0015556	16.577	11.792	920.47	1.397	0.0017566	20.318	10.864
849.18	1.396	0.0015856	16.920	11.776	921.83	1.397	0.0017820	20.643	10.848
850.34	1.396	0.0015171	16.211	11.760	923.19	1.397	0.0018449	21.403	10.832
851.50	1.396	0.0013635	14.590	11.744	924.56	1.397	0.0019048	22.131	10.816
852.66	1.397	0.0013513	14.479	11.728	925.93	1.396	0.0018328	21.326	10.800
853.83	1.397	0.0013719	14.720	11.712	927.30	1.396	0.0017228	20.075	10.784
854.99	1.397	0.0012944	13.907	11.696	928.68	1.396	0.0016604	19.377	10.768
856.16	1.397	0.0012885	13.863	11.680	930.06	1.396	0.0015599	18.231	10.752
857.34	1.397	0.0013023	14.030	11.664	931.45	1.397	0.0014209	16.631	10.736
858.52	1.397	0.0012944	13.965	11.648	937.03	1.397	0.0022985	27.065	10.672
859.70	1.397	0.0012662	13.679	11.632	939.85	1.397	0.0022942	27.096	10.640
860.88	1.397	0.0012855	13.907	11.616	941.27	1.397	0.0023373	27.646	10.624
862.07	1.397	0.0013999	15.165	11.600	942.68	1.396	0.0023502	27.841	10.608
863.26	1.397	0.0014514	15.745	11.584	946.97	1.396	0.0014908	17.741	10.560
864.45	1.397	0.0014897	16.183	11.568	948.41	1.397	0.0015333	18.274	10.544
865.65	1.398	0.0016189	17.611	11.552	949.85	1.397	0.0015969	19.061	10.528
866.85	1.398	0.0018258	19.889	11.536	951.29	1.397	0.0017214	20.578	10.512
868.06	1.398	0.0019563	21.340	11.520	954.20	1.397	0.0017493	20.975	10.480
869.26	1.398	0.0019447	21.243	11.504	955.66	1.397	0.0018159	21.807	10.464
870.47	1.398	0.0020431	22.349	11.488	958.59	1.397	0.0019335	23.291	10.432
871.69	1.398	0.0022004	24.103	11.472	960.06	1.397	0.0019475	23.495	10.416
872.91	1.398	0.0022485	24.664	11.456	961.54	1.397	0.0022387	27.050	10.400
874.13	1.398	0.0022017	24.185	11.440	964.51	1.397	0.0022875	27.725	10.368
875.35	1.398	0.0021626	23.788	11.424	966.00	1.397	0.0024054	29.199	10.352
876.58	1.398	0.0023858	26.281	11.408	967.49	1.397	0.0029186	35.484	10.336
877.81	1.398	0.0025635	28.278	11.392	970.50	1.396	0.0026769	32.647	10.304
879.04	1.398	0.0026143	28.879	11.376	972.01	1.396	0.0025211	30.794	10.288
880.28	1.398	0.0026657	29.488	11.360	976.56	1.396	0.0022135	27.164	10.240
882.77	1.398	0.0028518	31.636	11.328	978.09	1.396	0.0022411	27.545	10.224
884.02	1.399	0.0035363	39.284	11.312	979.62	1.396	0.0025735	31.680	10.208
885.27	1.398	0.0042428	47.200	11.296	981.16	1.396	0.0022740	28.038	10.192
886.52	1.398	0.0044967	50.095	11.280	985.80	1.396	0.0021968	27.214	10.144
887.78	1.397	0.0048969	54.631	11.264	987.36	1.396	0.0018864	23.406	10.128
889.05	1.397	0.0050956	56.929	11.248	990.49	1.396	0.0018276	22.748	10.096
890.31	1.396	0.0048622	54.398	11.232	992.06	1.396	0.0015691	19.561	10.080
891.58	1.395	0.0045853	51.373	11.216	993.64	1.396	0.0016222	20.255	10.064
892.86	1.395	0.0043072	48.327	11.200	995.22	1.396	0.0015885	19.866	10.048
894.13	1.395	0.0037258	41.863	11.184	996.81	1.396	0.0013306	16.667	10.032
895.42	1.395	0.0032155	36.181	11.168	998.40	1.396	0.0012501	15.684	10.016
896.70	1.395	0.0027059	30.491	11.152	1001.60	1.396	0.0011786	14.834	9.984
899.28	1.395	0.0025147	28.418	11.120	1004.82	1.396	0.0010741	13.563	9.952
900.58	1.395	0.0021328	24.137	11.104	1006.44	1.396	0.0011390	14.405	9.936
901.88	1.395	0.0018599	21.079	11.088	1008.06	1.396	0.0009962	12.620	9.920
903.18	1.395	0.0017132	19.444	11.072	1019.58	1.397	0.0009794	12.548	9.808
904.49	1.395	0.0016122	18.325	11.056	1024.59	1.397	0.0009787	12.601	9.760
905.80	1.395	0.0014266	16.239	11.040	1029.65	1.397	0.0010224	13.229	9.712
907.11	1.396	0.0013220	15.070	11.024	1031.35	1.398	0.0011753	15.232	9.696
908.43	1.396	0.0013114	14.970	11.008	1033.06	1.397	0.0013469	17.485	9.680
909.75	1.396	0.0013121	15.000	10.992	1034.77	1.398	0.0013270	17.255	9.664
911.08	1.396	0.0012766	14.616	10.976	1036.48	1.397	0.0014627	19.051	9.648
912.41	1.396	0.0012891	14.780	10.960	1046.90	1.397	0.0016093	21.171	9.552
913.74	1.396	0.0013761	15.801	10.944	1048.66	1.397	0.0015856	20.895	9.536
915.08	1.396	0.0014548	16.729	10.928	1050.42	1.398	0.0017607	23.241	9.520
916.42	1.397	0.0014673	16.897	10.912	1053.96	1.397	0.0017369	23.004	9.488
917.77	1.397	0.0015541	17.924	10.896	1061.12	1.397	0.0018958	25.279	9.424
919.12	1.397	0.0016884	19.501	10.880	1062.93	1.398	0.0019557	26.122	9.408

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1064.74	1.397	0.0021458	28.710	9.392	1195.03	1.398	0.0011144	16.735	8.368
1068.38	1.397	0.0022516	30.229	9.360	1197.32	1.398	0.0010681	16.071	8.352
1070.21	1.397	0.0021492	28.904	9.344	1199.62	1.399	0.0010219	15.405	8.336
1072.04	1.397	0.0021453	28.901	9.328	1201.92	1.399	0.0010460	15.799	8.320
1073.88	1.397	0.0017722	23.916	9.312	1204.24	1.399	0.0011238	17.007	8.304
1075.73	1.397	0.0017701	23.928	9.296	1206.56	1.399	0.0011823	17.926	8.288
1077.59	1.397	0.0019194	25.991	9.280	1208.90	1.399	0.0012469	18.943	8.272
1081.31	1.397	0.0021176	28.774	9.248	1211.24	1.399	0.0013851	21.082	8.256
1083.19	1.397	0.0022943	31.229	9.232	1213.59	1.399	0.0015067	22.978	8.240
1085.07	1.397	0.0022924	31.258	9.216	1215.95	1.399	0.0014878	22.734	8.224
1088.85	1.396	0.0024161	33.059	9.184	1218.32	1.399	0.0013032	19.952	8.208
1090.75	1.396	0.0020793	28.500	9.168	1220.70	1.399	0.0011895	18.246	8.192
1092.66	1.396	0.0019099	26.224	9.152	1223.09	1.399	0.0011463	17.618	8.176
1094.57	1.396	0.0014362	19.755	9.136	1225.49	1.399	0.0011490	17.695	8.160
1096.49	1.396	0.0010144	13.977	9.120	1227.90	1.399	0.0011308	17.449	8.144
1098.42	1.396	0.0008796	12.141	9.104	1230.31	1.399	0.0011384	17.600	8.128
1100.35	1.396	0.0008157	11.279	9.088	1232.74	1.399	0.0012071	18.699	8.112
1102.29	1.397	0.0007452	10.323	9.072	1235.18	1.399	0.0012262	19.032	8.096
1104.24	1.397	0.0006714	9.317	9.056	1237.62	1.400	0.0012923	20.098	8.080
1106.19	1.397	0.0006399	8.895	9.040	1240.08	1.400	0.0016505	25.721	8.064
1110.12	1.397	0.0006381	8.901	9.008	1242.54	1.400	0.0016849	26.309	8.048
1114.08	1.397	0.0007309	10.233	8.976	1252.51	1.400	0.0015061	23.705	7.984
1116.07	1.398	0.0007716	10.822	8.960	1255.02	1.400	0.0011605	18.302	7.968
1118.07	1.398	0.0009148	12.853	8.944	1257.55	1.400	0.0011611	18.348	7.952
1120.07	1.398	0.0010577	14.888	8.928	1260.08	1.400	0.0013794	21.842	7.936
1126.13	1.398	0.0009485	13.422	8.880	1262.63	1.401	0.0014795	23.475	7.920
1128.16	1.398	0.0009829	13.935	8.864	1265.18	1.401	0.0018072	28.732	7.904
1130.20	1.398	0.0011834	16.807	8.848	1267.75	1.401	0.0022621	36.038	7.888
1132.25	1.398	0.0016312	23.209	8.832	1270.33	1.401	0.0023999	38.311	7.872
1134.30	1.398	0.0016468	23.473	8.816	1272.91	1.401	0.0025470	40.741	7.856
1136.36	1.398	0.0017917	25.585	8.800	1275.51	1.400	0.0025496	40.866	7.840
1138.43	1.398	0.0018989	27.166	8.784	1278.12	1.400	0.0022479	36.104	7.824
1140.51	1.397	0.0018283	26.203	8.768	1280.74	1.401	0.0021459	34.536	7.808
1142.60	1.397	0.0017940	25.759	8.752	1283.37	1.401	0.0024977	40.281	7.792
1144.69	1.397	0.0015396	22.147	8.736	1286.01	1.401	0.0027216	43.982	7.776
1146.79	1.397	0.0013010	18.749	8.720	1288.66	1.401	0.0030423	49.267	7.760
1148.90	1.397	0.0011825	17.072	8.704	1291.32	1.401	0.0036682	59.525	7.744
1151.01	1.397	0.0011010	15.925	8.688	1294.00	1.401	0.0040146	65.281	7.728
1153.14	1.397	0.0010718	15.531	8.672	1299.38	1.400	0.0039743	64.894	7.696
1155.27	1.398	0.0010977	15.936	8.656	1302.08	1.400	0.0034610	56.631	7.680
1157.41	1.398	0.0010435	15.177	8.640	1304.80	1.400	0.0028359	46.499	7.664
1159.55	1.398	0.0009828	14.321	8.624	1310.27	1.400	0.0028299	46.596	7.632
1161.71	1.398	0.0009335	13.627	8.608	1313.03	1.401	0.0028159	46.462	7.616
1163.87	1.398	0.0009013	13.182	8.592	1315.79	1.401	0.0028897	47.781	7.600
1166.04	1.398	0.0008476	12.420	8.576	1318.57	1.401	0.0030217	50.068	7.584
1170.41	1.398	0.0008263	12.153	8.544	1321.35	1.401	0.0028667	47.601	7.568
1172.61	1.398	0.0008967	13.214	8.528	1324.15	1.401	0.0029669	49.368	7.552
1174.81	1.398	0.0009294	13.721	8.512	1326.96	1.401	0.0031171	51.978	7.536
1177.02	1.398	0.0010396	15.376	8.496	1329.79	1.401	0.0031178	52.100	7.520
1179.25	1.398	0.0011701	17.340	8.480	1332.62	1.401	0.0030917	51.775	7.504
1181.47	1.398	0.0012058	17.903	8.464	1335.47	1.402	0.0032957	55.308	7.488
1183.71	1.398	0.0012350	18.371	8.448	1338.33	1.401	0.0033019	55.532	7.472
1185.96	1.398	0.0013064	19.469	8.432	1341.20	1.402	0.0028743	48.443	7.456
1188.21	1.398	0.0013362	19.951	8.416	1344.09	1.402	0.0025552	43.159	7.440
1190.48	1.398	0.0011986	17.931	8.400	1346.98	1.403	0.0025066	42.428	7.424
1192.75	1.398	0.0011127	16.678	8.384	1349.89	1.404	0.0027047	45.880	7.408

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1352.81	1.405	0.0031230	53.090	7.392	1586.29	1.391	0.0005424	10.813	6.304
1355.75	1.405	0.0038221	65.117	7.376	1590.33	1.391	0.0005420	10.831	6.288
1358.70	1.406	0.0049043	83.735	7.360	1594.39	1.391	0.0005185	10.388	6.272
1361.66	1.407	0.0063723	109.037	7.344	1598.47	1.391	0.0004870	9.783	6.256
1364.63	1.407	0.0087866	150.676	7.328	1602.56	1.391	0.0004667	9.399	6.240
1367.61	1.407	0.0111146	191.014	7.312	1606.68	1.391	0.0004503	9.092	6.224
1370.61	1.404	0.0146284	251.953	7.296	1610.82	1.391	0.0004239	8.580	6.208
1373.63	1.399	0.0147019	253.778	7.280	1614.99	1.392	0.0004379	8.886	6.192
1376.65	1.396	0.0116320	201.227	7.264	1619.17	1.392	0.0004376	8.903	6.176
1379.69	1.395	0.0078204	135.588	7.248	1623.38	1.392	0.0004109	8.382	6.160
1382.74	1.396	0.0053127	92.313	7.232	1627.60	1.392	0.0003871	7.918	6.144
1385.81	1.398	0.0036948	64.343	7.216	1631.85	1.392	0.0003907	8.012	6.128
1388.89	1.399	0.0036363	63.466	7.200	1649.08	1.392	0.0003826	7.928	6.064
1391.98	1.400	0.0036646	64.101	7.184	1653.44	1.392	0.0003850	7.999	6.048
1395.09	1.401	0.0035946	63.017	7.168	1657.82	1.393	0.0003862	8.045	6.032
1398.21	1.402	0.0033539	58.929	7.152	1671.12	1.393	0.0003843	8.070	5.984
1401.35	1.403	0.0031206	54.954	7.136	1684.64	1.393	0.0003887	8.228	5.936
1404.49	1.404	0.0029547	52.149	7.120	1689.19	1.393	0.0003686	7.825	5.920
1407.66	1.406	0.0034405	60.859	7.104	1693.77	1.393	0.0003325	7.077	5.904
1410.84	1.407	0.0039720	70.421	7.088	1698.37	1.393	0.0003321	7.088	5.888
1414.03	1.408	0.0047119	83.726	7.072	1707.65	1.393	0.0003311	7.105	5.856
1417.23	1.409	0.0054028	96.220	7.056	1712.33	1.393	0.0003188	6.860	5.840
1420.45	1.411	0.0059683	106.533	7.040	1717.03	1.393	0.0002954	6.374	5.824
1423.69	1.415	0.0069135	123.686	7.024	1721.76	1.393	0.0002552	5.521	5.808
1426.94	1.417	0.0142915	256.268	7.008	1726.52	1.393	0.0002423	5.258	5.792
1430.21	1.415	0.0168513	302.861	6.992	1731.30	1.393	0.0002261	4.918	5.776
1433.49	1.414	0.0192023	345.906	6.976	1736.11	1.393	0.0002097	4.574	5.760
1436.78	1.415	0.0207508	374.658	6.960	1740.95	1.394	0.0002021	4.421	5.744
1440.09	1.415	0.0246960	446.917	6.944	1745.81	1.394	0.0001867	4.096	5.728
1443.42	1.415	0.0296566	537.928	6.928	1750.70	1.394	0.0001868	4.110	5.712
1446.76	1.413	0.0349536	635.474	6.912	1755.62	1.394	0.0001854	4.090	5.696
1450.12	1.409	0.0410636	748.292	6.896	1760.56	1.394	0.0001706	3.774	5.680
1453.49	1.402	0.0487118	889.726	6.880	1765.54	1.394	0.0001848	4.099	5.664
1456.88	1.390	0.0503829	922.394	6.864	1770.54	1.394	0.0001774	3.947	5.648
1460.28	1.377	0.0473671	869.207	6.848	1775.57	1.394	0.0001769	3.948	5.632
1467.14	1.363	0.0279254	514.851	6.816	1780.63	1.394	0.0001620	3.624	5.616
1470.59	1.364	0.0170336	314.781	6.800	1785.71	1.394	0.0001570	3.524	5.600
1474.06	1.368	0.0125496	232.464	6.784	1790.83	1.394	0.0001609	3.620	5.584
1477.54	1.370	0.0106025	196.860	6.768	1795.98	1.394	0.0001471	3.319	5.568
1481.04	1.372	0.0044973	83.700	6.752	1801.15	1.394	0.0001301	2.945	5.552
1484.56	1.376	0.0036253	67.631	6.736	1816.86	1.394	0.0001267	2.893	5.504
1488.10	1.378	0.0031590	59.074	6.720	1832.84	1.394	0.0001275	2.936	5.456
1491.65	1.380	0.0028069	52.614	6.704	1838.24	1.394	0.0001190	2.749	5.440
1495.22	1.381	0.0028463	53.481	6.688	1843.66	1.394	0.0001214	2.813	5.424
1498.80	1.382	0.0025574	48.167	6.672	1849.11	1.395	0.0001241	2.883	5.408
1502.40	1.383	0.0020720	39.118	6.656	1851.85	1.395	0.0001274	2.964	5.400
1506.02	1.384	0.0015388	29.123	6.640	1854.60	1.395	0.0001295	3.018	5.392
1513.32	1.385	0.0013933	26.497	6.608	1857.36	1.395	0.0001298	3.029	5.384
1516.99	1.386	0.0014108	26.894	6.592	1860.12	1.395	0.0001372	3.207	5.376
1524.39	1.387	0.0013883	26.595	6.560	1862.89	1.395	0.0001414	3.310	5.368
1528.12	1.387	0.0010831	20.798	6.544	1865.67	1.395	0.0001429	3.351	5.360
1531.86	1.387	0.0008997	17.320	6.528	1868.46	1.395	0.0001497	3.514	5.352
1539.41	1.388	0.0008449	16.345	6.496	1871.26	1.395	0.0001537	3.615	5.344
1550.87	1.389	0.0007446	14.511	6.448	1874.06	1.395	0.0001571	3.700	5.336
1578.28	1.390	0.0006036	11.971	6.336	1876.88	1.395	0.0001581	3.728	5.328
1582.28	1.390	0.0005631	11.197	6.320	1879.70	1.395	0.0001595	3.768	5.320

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1882.53	1.395	0.0001552	3.671	5.312	2055.92	1.396	0.0001890	4.882	4.864
1885.37	1.395	0.0001527	3.618	5.304	2059.31	1.396	0.0001807	4.675	4.856
1888.22	1.395	0.0001495	3.548	5.296	2062.71	1.396	0.0001700	4.407	4.848
1891.07	1.395	0.0001396	3.317	5.288	2066.12	1.396	0.0001638	4.252	4.840
1893.94	1.395	0.0001356	3.228	5.280	2069.54	1.396	0.0001591	4.138	4.832
1896.81	1.395	0.0001372	3.270	5.272	2072.97	1.396	0.0001547	4.031	4.824
1899.70	1.395	0.0001358	3.241	5.264	2076.41	1.396	0.0001514	3.951	4.816
1902.59	1.395	0.0001350	3.228	5.256	2079.87	1.396	0.0001497	3.912	4.808
1905.49	1.395	0.0001400	3.352	5.248	2083.33	1.396	0.0001498	3.923	4.800
1908.40	1.395	0.0001459	3.499	5.240	2086.81	1.396	0.0001502	3.938	4.792
1911.31	1.395	0.0001465	3.519	5.232	2090.30	1.396	0.0001495	3.927	4.784
1914.24	1.395	0.0001467	3.529	5.224	2093.80	1.396	0.0001538	4.047	4.776
1917.18	1.395	0.0001433	3.453	5.216	2097.32	1.396	0.0001580	4.164	4.768
1920.12	1.395	0.0001425	3.439	5.208	2100.84	1.396	0.0001589	4.195	4.760
1923.08	1.395	0.0001393	3.366	5.200	2104.38	1.396	0.0001604	4.242	4.752
1926.04	1.395	0.0001325	3.207	5.192	2107.93	1.396	0.0001637	4.337	4.744
1929.01	1.395	0.0001285	3.114	5.184	2111.49	1.396	0.0001653	4.386	4.736
1931.99	1.395	0.0001212	2.942	5.176	2115.06	1.396	0.0001664	4.423	4.728
1934.98	1.395	0.0001187	2.886	5.168	2118.64	1.396	0.0001688	4.493	4.720
1937.98	1.395	0.0001167	2.842	5.160	2122.24	1.396	0.0001780	4.746	4.712
1940.99	1.395	0.0001127	2.748	5.152	2125.85	1.396	0.0001849	4.940	4.704
1944.01	1.395	0.0001099	2.684	5.144	2129.47	1.396	0.0001943	5.200	4.696
1947.04	1.395	0.0001127	2.758	5.136	2133.11	1.396	0.0002093	5.611	4.688
1950.08	1.395	0.0001110	2.721	5.128	2136.75	1.396	0.0002185	5.866	4.680
1953.13	1.395	0.0001121	2.752	5.120	2140.41	1.396	0.0002302	6.193	4.672
1956.18	1.395	0.0001159	2.848	5.112	2144.08	1.396	0.0002407	6.486	4.664
1959.25	1.395	0.0001163	2.863	5.104	2147.77	1.396	0.0002467	6.659	4.656
1962.32	1.395	0.0001148	2.832	5.096	2151.46	1.396	0.0002489	6.729	4.648
1965.41	1.395	0.0001144	2.825	5.088	2155.17	1.396	0.0002517	6.816	4.640
1968.50	1.395	0.0001165	2.882	5.080	2158.89	1.396	0.0002498	6.778	4.632
1971.61	1.395	0.0001141	2.826	5.072	2162.63	1.396	0.0002475	6.727	4.624
1974.72	1.395	0.0001120	2.780	5.064	2166.38	1.396	0.0002460	6.698	4.616
1977.85	1.395	0.0001166	2.898	5.056	2170.14	1.396	0.0002476	6.753	4.608
1980.98	1.395	0.0001161	2.891	5.048	2173.91	1.396	0.0002476	6.764	4.600
1984.13	1.395	0.0001164	2.901	5.040	2177.70	1.396	0.0002489	6.810	4.592
1987.28	1.395	0.0001202	3.002	5.032	2181.50	1.396	0.0002502	6.860	4.584
1990.45	1.395	0.0001273	3.183	5.024	2185.31	1.396	0.0002536	6.964	4.576
1993.62	1.395	0.0001343	3.364	5.016	2189.14	1.396	0.0002549	7.012	4.568
1996.81	1.396	0.0001470	3.689	5.008	2192.98	1.396	0.0002536	6.989	4.560
2000.00	1.396	0.0001575	3.959	5.000	2196.84	1.396	0.0002540	7.013	4.552
2003.21	1.396	0.0001778	4.476	4.992	2200.70	1.397	0.0002530	6.997	4.544
2006.42	1.396	0.0002000	5.043	4.984	2204.59	1.397	0.0002489	6.895	4.536
2009.65	1.396	0.0002191	5.532	4.976	2208.48	1.397	0.0002466	6.843	4.528
2012.88	1.396	0.0002456	6.212	4.968	2212.39	1.397	0.0002477	6.887	4.520
2016.13	1.396	0.0002668	6.760	4.960	2216.31	1.397	0.0002519	7.015	4.512
2019.39	1.396	0.0002801	7.108	4.952	2220.25	1.397	0.0002563	7.152	4.504
2022.65	1.396	0.0002909	7.395	4.944	2224.20	1.397	0.0002583	7.220	4.496
2025.93	1.396	0.0002902	7.387	4.936	2228.16	1.397	0.0002625	7.350	4.488
2029.22	1.396	0.0002833	7.225	4.928	2232.14	1.397	0.0002650	7.434	4.480
2032.52	1.396	0.0002735	6.985	4.920	2236.14	1.397	0.0002669	7.500	4.472
2035.83	1.396	0.0002613	6.685	4.912	2240.14	1.397	0.0002698	7.595	4.464
2039.15	1.396	0.0002451	6.280	4.904	2244.17	1.397	0.0002724	7.681	4.456
2042.48	1.396	0.0002322	5.960	4.896	2248.20	1.397	0.0002752	7.776	4.448
2045.83	1.396	0.0002227	5.726	4.888	2252.25	1.397	0.0002775	7.854	4.440
2049.18	1.396	0.0002096	5.397	4.880	2256.32	1.397	0.0002812	7.972	4.432
2052.55	1.396	0.0001956	5.044	4.872	2260.40	1.397	0.0002841	8.069	4.424

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2264.49	1.397	0.0002844	8.092	4.416	2520.16	1.400	0.0003998	12.661	3.968
2268.60	1.397	0.0002873	8.191	4.408	2525.25	1.400	0.0004203	13.338	3.960
2272.73	1.397	0.0002888	8.249	4.400	2530.36	1.400	0.0004381	13.930	3.952
2276.87	1.397	0.0002890	8.269	4.392	2535.50	1.400	0.0004550	14.497	3.944
2281.02	1.397	0.0002927	8.389	4.384	2540.65	1.400	0.0004770	15.229	3.936
2285.19	1.397	0.0002991	8.590	4.376	2545.82	1.400	0.0004979	15.928	3.928
2289.38	1.397	0.0003061	8.806	4.368	2551.02	1.400	0.0005313	17.032	3.920
2293.58	1.397	0.0003125	9.008	4.360	2556.24	1.400	0.0005649	18.147	3.912
2297.79	1.397	0.0003229	9.324	4.352	2561.48	1.400	0.0006065	19.522	3.904
2302.03	1.397	0.0003339	9.659	4.344	2566.74	1.400	0.0006520	21.031	3.896
2306.27	1.397	0.0003435	9.955	4.336	2577.32	1.401	0.0006738	21.823	3.880
2310.54	1.397	0.0003527	10.241	4.328	2582.64	1.401	0.0007393	23.993	3.872
2314.81	1.397	0.0003611	10.504	4.320	2587.99	1.401	0.0007977	25.941	3.864
2319.11	1.397	0.0003719	10.837	4.312	2593.36	1.401	0.0008467	27.594	3.856
2323.42	1.397	0.0003785	11.050	4.304	2598.75	1.401	0.0008858	28.928	3.848
2327.75	1.397	0.0003902	11.415	4.296	2604.17	1.401	0.0009083	29.725	3.840
2332.09	1.397	0.0003981	11.666	4.288	2609.60	1.401	0.0009508	31.179	3.832
2336.45	1.397	0.0003923	11.517	4.280	2615.06	1.401	0.0009907	32.556	3.824
2340.82	1.397	0.0003858	11.348	4.272	2620.55	1.402	0.0010086	33.215	3.816
2345.22	1.397	0.0003843	11.326	4.264	2626.05	1.402	0.0010485	34.602	3.808
2349.62	1.397	0.0003783	11.170	4.256	2631.58	1.402	0.0011159	36.903	3.800
2354.05	1.397	0.0003636	10.757	4.248	2637.13	1.402	0.0011842	39.245	3.792
2358.49	1.397	0.0003542	10.499	4.240	2642.71	1.402	0.0012533	41.620	3.784
2362.95	1.398	0.0003473	10.314	4.232	2648.31	1.402	0.0013151	43.767	3.776
2367.42	1.398	0.0003538	10.525	4.224	2653.93	1.402	0.0013755	45.872	3.768
2371.92	1.398	0.0003442	10.258	4.216	2659.57	1.402	0.0014219	47.522	3.760
2376.43	1.398	0.0003385	10.110	4.208	2665.25	1.403	0.0014420	48.296	3.752
2380.95	1.398	0.0003362	10.059	4.200	2670.94	1.403	0.0014198	47.654	3.744
2385.50	1.398	0.0003336	10.001	4.192	2676.66	1.403	0.0013715	46.130	3.736
2390.06	1.398	0.0003340	10.030	4.184	2682.40	1.403	0.0013397	45.157	3.728
2394.64	1.398	0.0003346	10.070	4.176	2688.17	1.403	0.0013341	45.068	3.720
2399.23	1.398	0.0003310	9.980	4.168	2693.97	1.404	0.0013470	45.599	3.712
2403.85	1.398	0.0003266	9.865	4.160	2699.78	1.404	0.0013655	46.325	3.704
2408.48	1.398	0.0003251	9.840	4.152	2705.63	1.404	0.0014217	48.339	3.696
2413.13	1.398	0.0003227	9.785	4.144	2711.50	1.405	0.0015198	51.784	3.688
2417.79	1.398	0.0003181	9.666	4.136	2717.39	1.405	0.0016053	54.816	3.680
2422.48	1.398	0.0003084	9.387	4.128	2723.31	1.405	0.0016284	55.727	3.672
2427.18	1.398	0.0002974	9.072	4.120	2729.26	1.406	0.0016434	56.365	3.664
2431.91	1.398	0.0002866	8.760	4.112	2735.23	1.406	0.0015796	54.293	3.656
2436.65	1.398	0.0002741	8.394	4.104	2741.23	1.407	0.0015745	54.237	3.648
2441.41	1.398	0.0002586	7.935	4.096	2747.25	1.407	0.0015493	53.486	3.640
2446.18	1.398	0.0002455	7.548	4.088	2753.30	1.408	0.0015741	54.461	3.632
2450.98	1.398	0.0002358	7.264	4.080	2759.38	1.409	0.0016564	57.438	3.624
2455.80	1.398	0.0002275	7.022	4.072	2765.49	1.410	0.0018489	64.255	3.616
2460.63	1.399	0.0002209	6.829	4.064	2771.62	1.411	0.0021412	74.578	3.608
2465.48	1.399	0.0002202	6.823	4.056	2777.78	1.412	0.0025312	88.354	3.600
2470.36	1.399	0.0002229	6.920	4.048	2783.96	1.413	0.0029580	103.484	3.592
2475.25	1.399	0.0002303	7.162	4.040	2790.18	1.414	0.0034654	121.504	3.584
2480.16	1.399	0.0002418	7.535	4.032	2796.42	1.415	0.0040069	140.807	3.576
2485.09	1.399	0.0002567	8.015	4.024	2802.69	1.417	0.0046885	165.128	3.568
2490.04	1.399	0.0002750	8.605	4.016	2808.99	1.418	0.0053886	190.212	3.560
2495.01	1.399	0.0002956	9.268	4.008	2815.32	1.421	0.0056699	200.592	3.552
2500.00	1.399	0.0003186	10.008	4.000	2821.67	1.425	0.0089598	317.698	3.544
2505.01	1.399	0.0003617	11.387	3.992	2828.05	1.428	0.0132669	471.482	3.536
2510.04	1.399	0.0003628	11.444	3.984	2834.47	1.429	0.0193230	688.267	3.528
2515.09	1.399	0.0003808	12.034	3.976	2840.91	1.428	0.0241907	863.608	3.520

NONANE					NONANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2847.38	1.427	0.0297516	1064.550	3.512	3280.84	1.389	0.0001374	5.665	3.048
2853.88	1.423	0.0341149	1223.461	3.504	3289.47	1.389	0.0001339	5.534	3.040
2860.41	1.419	0.0364206	1309.136	3.496	3298.15	1.389	0.0001304	5.406	3.032
2866.97	1.415	0.0372459	1341.874	3.488	3306.88	1.389	0.0001293	5.374	3.024
2873.56	1.412	0.0367412	1326.732	3.480	3315.65	1.389	0.0001309	5.455	3.016
2880.18	1.412	0.0367917	1331.616	3.472	3324.47	1.390	0.0001332	5.566	3.008
2886.84	1.412	0.0389333	1412.388	3.464	3333.33	1.390	0.0001339	5.609	3.000
2893.52	1.412	0.0411575	1496.528	3.456	3342.25	1.390	0.0001338	5.618	2.992
2900.23	1.412	0.0466901	1701.639	3.448	3351.21	1.390	0.0001348	5.678	2.984
2906.98	1.408	0.0536979	1961.593	3.440	3360.22	1.390	0.0001324	5.589	2.976
2913.75	1.401	0.0614465	2249.879	3.432	3369.27	1.390	0.0001298	5.497	2.968
2920.56	1.388	0.0652031	2393.008	3.424	3378.38	1.390	0.0001252	5.314	2.960
2927.40	1.373	0.0609311	2241.460	3.416	3387.53	1.390	0.0001215	5.170	2.952
2934.27	1.363	0.0518475	1911.779	3.408	3396.74	1.390	0.0001158	4.945	2.944
2941.18	1.357	0.0414513	1532.040	3.400	3405.99	1.390	0.0001089	4.661	2.936
2948.11	1.355	0.0319655	1184.227	3.392	3415.30	1.390	0.0001019	4.373	2.928
2955.08	1.355	0.0243848	905.521	3.384	3424.66	1.391	0.0000927	3.991	2.920
2962.09	1.357	0.0173338	645.211	3.376	3434.07	1.391	0.0000863	3.725	2.912
2969.12	1.359	0.0120380	449.152	3.368	3443.53	1.391	0.0000785	3.398	2.904
2976.19	1.363	0.0078091	292.060	3.360	3453.04	1.391	0.0000705	3.060	2.896
2983.29	1.366	0.0055989	209.898	3.352	3462.60	1.391	0.0000650	2.830	2.888
2990.43	1.369	0.0045279	170.153	3.344	3472.22	1.391	0.0000588	2.567	2.880
2997.60	1.371	0.0037931	142.882	3.336	3481.89	1.391	0.0000542	2.372	2.872
3004.81	1.373	0.0031495	118.924	3.328	3491.62	1.391	0.0000526	2.309	2.864
3012.05	1.375	0.0026577	100.597	3.320	3501.40	1.391	0.0000525	2.309	2.856
3019.32	1.376	0.0022441	85.144	3.312	3511.24	1.391	0.0000544	2.400	2.848
3026.63	1.377	0.0018912	71.931	3.304	3521.13	1.391	0.0000571	2.527	2.840
3033.98	1.378	0.0015966	60.873	3.296	3531.07	1.391	0.0000640	2.838	2.832
3041.36	1.379	0.0013415	51.269	3.288	3541.08	1.391	0.0000742	3.303	2.824
3048.78	1.380	0.0012389	47.465	3.280	3551.14	1.391	0.0000888	3.961	2.816
3056.23	1.381	0.0010780	41.401	3.272	3561.25	1.392	0.0001052	4.708	2.808
3063.73	1.381	0.0009529	36.687	3.264	3571.43	1.392	0.0001212	5.440	2.800
3071.25	1.382	0.0008494	32.782	3.256	3581.66	1.392	0.0001437	6.467	2.792
3078.82	1.382	0.0007531	29.137	3.248	3591.95	1.392	0.0001635	7.380	2.784
3086.42	1.383	0.0006920	26.840	3.240	3602.31	1.392	0.0001788	8.093	2.776
3094.06	1.383	0.0006320	24.574	3.232	3612.72	1.392	0.0001909	8.667	2.768
3101.74	1.384	0.0005865	22.860	3.224	3623.19	1.392	0.0001985	9.038	2.760
3109.45	1.384	0.0005449	21.291	3.216	3633.72	1.392	0.0001993	9.102	2.752
3117.21	1.385	0.0005274	20.658	3.208	3644.31	1.392	0.0001969	9.019	2.744
3125.00	1.385	0.0005100	20.029	3.200	3654.97	1.392	0.0001938	8.899	2.736
3132.83	1.385	0.0004884	19.228	3.192	3665.69	1.392	0.0001910	8.800	2.728
3140.70	1.386	0.0004779	18.863	3.184	3676.47	1.392	0.0001883	8.698	2.720
3148.61	1.386	0.0004672	18.484	3.176	3687.32	1.392	0.0001833	8.494	2.712
3156.57	1.386	0.0004575	18.148	3.168	3698.22	1.392	0.0001829	8.500	2.704
3164.56	1.386	0.0004420	17.578	3.160	3709.20	1.392	0.0001846	8.606	2.696
3188.78	1.387	0.0004250	17.032	3.136	3720.24	1.392	0.0001856	8.677	2.688
3196.93	1.387	0.0003825	15.367	3.128	3731.34	1.392	0.0001886	8.841	2.680
3205.13	1.387	0.0003321	13.376	3.120	3742.51	1.392	0.0001922	9.041	2.672
3213.37	1.388	0.0002924	11.809	3.112	3753.75	1.392	0.0001951	9.201	2.664
3221.65	1.388	0.0002559	10.361	3.104	3765.06	1.392	0.0001979	9.363	2.656
3229.97	1.388	0.0002232	9.060	3.096	3776.44	1.392	0.0001997	9.477	2.648
3238.34	1.388	0.0001998	8.130	3.088	3787.88	1.392	0.0002105	10.021	2.640
3246.75	1.388	0.0001802	7.353	3.080	3799.39	1.392	0.0002052	9.799	2.632
3255.21	1.388	0.0001645	6.730	3.072	3810.98	1.392	0.0002076	9.944	2.624
3263.71	1.389	0.0001501	6.154	3.064	3822.63	1.392	0.0002097	10.071	2.616
3272.25	1.389	0.0001417	5.828	3.056	3834.36	1.393	0.0002095	10.094	2.608

frequency cm ⁻¹	NONANE			wavelength microns
	n	k	alpha cm ⁻¹	
3846.15	1.393	0.0002107	10.183	2.600
3858.02	1.393	0.0002107	10.213	2.592
3869.97	1.393	0.0002096	10.193	2.584
3881.99	1.393	0.0002126	10.370	2.576
3894.08	1.393	0.0002212	10.826	2.568
3906.25	1.393	0.0002229	10.943	2.560
4000.00	1.393	0.0003277	16.470	2.500
4090.00	1.393	0.0005457	28.047	2.445
4336.00	1.393	0.0007183	39.141	2.306
4390.00	1.393	0.0003991	22.017	2.278
4444.00	1.393	0.0002245	12.535	2.250
4615.00	1.393	0.0000526	3.053	2.167
4864.00	1.394	0.0000131	0.803	2.056
5000.00	1.394	0.0000128	0.803	2.000

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
666.00	1.408	0.0000478	0.400	15.015	767.81	1.399	0.0047517	45.847	13.024
678.00	1.409	0.0001182	1.007	14.749	768.76	1.400	0.0043065	41.603	13.008
695.00	1.412	0.0014770	12.900	14.388	769.70	1.400	0.0045931	44.426	12.992
702.00	1.414	0.0033475	29.530	14.245	772.56	1.399	0.0042449	41.210	12.944
709.00	1.417	0.0059442	52.960	14.104	773.51	1.399	0.0036926	35.893	12.928
713.00	1.420	0.0103830	93.030	14.025	775.43	1.399	0.0034110	33.238	12.896
714.29	1.420	0.0127303	114.268	14.000	776.40	1.399	0.0027886	27.207	12.880
715.10	1.420	0.0139173	125.064	13.984	777.36	1.399	0.0029152	28.478	12.864
715.92	1.420	0.0140425	126.334	13.968	778.33	1.399	0.0028521	27.896	12.848
716.74	1.420	0.0170315	153.400	13.952	779.30	1.399	0.0023740	23.249	12.832
717.57	1.421	0.0231094	208.383	13.936	781.25	1.399	0.0022455	22.045	12.800
718.39	1.417	0.0244624	220.836	13.920	782.23	1.400	0.0019786	19.449	12.784
720.05	1.414	0.0244383	221.128	13.888	784.19	1.400	0.0019922	19.632	12.752
720.88	1.412	0.0306834	277.956	13.872	785.18	1.400	0.0019555	19.294	12.736
721.71	1.403	0.0311721	282.708	13.856	788.15	1.400	0.0019352	19.166	12.688
722.54	1.399	0.0239344	217.317	13.840	789.14	1.400	0.0019038	18.880	12.672
723.38	1.400	0.0222098	201.893	13.824	791.14	1.401	0.0017770	17.667	12.640
725.06	1.399	0.0192271	175.185	13.792	794.16	1.401	0.0016458	16.425	12.592
726.74	1.397	0.0176611	161.290	13.760	795.17	1.401	0.0016450	16.438	12.576
727.59	1.397	0.0161808	147.944	13.744	797.19	1.401	0.0016327	16.356	12.544
728.44	1.397	0.0147165	134.712	13.728	800.26	1.401	0.0015885	15.975	12.496
730.14	1.397	0.0149862	137.502	13.696	803.34	1.401	0.0015880	16.031	12.448
730.99	1.396	0.0132622	121.825	13.680	806.45	1.401	0.0015669	15.879	12.400
731.85	1.397	0.0121675	111.901	13.664	807.49	1.401	0.0015436	15.664	12.384
733.57	1.397	0.0119762	110.400	13.632	809.59	1.402	0.0016193	16.474	12.352
735.29	1.396	0.0108065	99.852	13.600	810.64	1.401	0.0016495	16.804	12.336
736.16	1.396	0.0097772	90.447	13.584	811.69	1.401	0.0015356	15.663	12.320
737.03	1.397	0.0097176	90.002	13.568	812.74	1.402	0.0015088	15.409	12.304
739.65	1.396	0.0094240	87.593	13.520	814.86	1.401	0.0015014	15.374	12.272
740.52	1.395	0.0082992	77.229	13.504	815.93	1.401	0.0013712	14.060	12.256
741.40	1.396	0.0075621	70.454	13.488	816.99	1.402	0.0013371	13.727	12.240
742.28	1.396	0.0075477	70.404	13.472	818.06	1.402	0.0012920	13.282	12.224
744.05	1.395	0.0072624	67.903	13.440	819.14	1.402	0.0011420	11.755	12.208
744.93	1.395	0.0055185	51.659	13.424	820.21	1.402	0.0011153	11.495	12.192
745.82	1.396	0.0046985	44.036	13.408	821.29	1.402	0.0011097	11.452	12.176
747.61	1.397	0.0040714	38.250	13.376	824.54	1.402	0.0010693	11.079	12.128
748.50	1.397	0.0039817	37.451	13.360	827.81	1.402	0.0010855	11.292	12.080
749.40	1.397	0.0034465	32.457	13.344	828.91	1.402	0.0011802	12.293	12.064
751.20	1.398	0.0032953	31.107	13.312	830.01	1.402	0.0011568	12.066	12.048
752.11	1.399	0.0032367	30.591	13.296	831.12	1.403	0.0011761	12.284	12.032
753.92	1.399	0.0031231	29.589	13.264	832.22	1.403	0.0013029	13.626	12.016
754.83	1.400	0.0031367	29.753	13.248	833.33	1.403	0.0013223	13.847	12.000
755.74	1.400	0.0031320	29.744	13.232	834.45	1.403	0.0013124	13.762	11.984
757.58	1.401	0.0031568	30.053	13.200	835.56	1.403	0.0014678	15.412	11.968
758.50	1.401	0.0036726	35.006	13.184	836.68	1.403	0.0014507	15.253	11.952
759.42	1.401	0.0037689	35.967	13.168	837.80	1.403	0.0014271	15.025	11.936
761.27	1.401	0.0040210	38.467	13.136	838.93	1.403	0.0015257	16.085	11.920
762.20	1.401	0.0046215	44.265	13.120	840.05	1.403	0.0016055	16.949	11.904
763.13	1.401	0.0045671	43.798	13.104	841.18	1.403	0.0014940	15.793	11.888
764.06	1.401	0.0046156	44.317	13.088	842.32	1.403	0.0014951	15.825	11.872
764.99	1.401	0.0048786	46.899	13.072	843.45	1.403	0.0016305	17.281	11.856
765.93	1.400	0.0051794	49.851	13.056	844.59	1.403	0.0015891	16.866	11.840
766.87	1.400	0.0051669	49.792	13.040	845.74	1.403	0.0015134	16.085	11.824
					846.88	1.403	0.0015591	16.592	11.808
					848.03	1.403	0.0015515	16.534	11.792
					849.18	1.403	0.0014899	15.899	11.776

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
850.34	1.403	0.0014888	15.909	11.760	938.44	1.402	0.0016554	19.522	10.656
851.50	1.403	0.0015082	16.138	11.744	939.85	1.402	0.0016100	19.015	10.640
852.66	1.403	0.0014682	15.732	11.728	941.27	1.402	0.0015398	18.213	10.624
854.99	1.403	0.0014864	15.970	11.696	942.68	1.402	0.0014345	16.993	10.608
856.16	1.403	0.0014612	15.721	11.680	944.11	1.402	0.0014357	17.033	10.592
858.52	1.403	0.0014055	15.164	11.648	945.54	1.402	0.0014411	17.123	10.576
859.70	1.403	0.0014544	15.712	11.632	948.41	1.402	0.0013890	16.554	10.544
862.07	1.403	0.0014096	15.270	11.600	949.85	1.402	0.0013608	16.243	10.528
863.26	1.403	0.0014673	15.918	11.584	951.29	1.402	0.0013008	15.550	10.512
864.45	1.403	0.0014486	15.736	11.568	952.74	1.402	0.0012851	15.386	10.496
865.65	1.403	0.0014839	16.142	11.552	954.20	1.402	0.0012690	15.216	10.480
866.85	1.403	0.0016094	17.532	11.536	955.66	1.402	0.0012101	14.532	10.464
868.06	1.403	0.0015999	17.452	11.520	957.12	1.402	0.0011627	13.985	10.448
869.26	1.403	0.0015838	17.301	11.504	958.59	1.402	0.0011635	14.016	10.432
870.47	1.404	0.0017221	18.837	11.488	960.06	1.402	0.0011344	13.686	10.416
872.91	1.404	0.0017883	19.616	11.456	968.99	1.403	0.0011357	13.829	10.320
874.13	1.404	0.0018874	20.733	11.440	972.01	1.403	0.0011189	13.668	10.288
875.35	1.404	0.0020221	22.243	11.424	975.04	1.403	0.0011857	14.529	10.256
876.58	1.404	0.0020453	22.530	11.408	978.09	1.403	0.0011770	14.467	10.224
879.04	1.404	0.0021073	23.278	11.376	981.16	1.403	0.0011997	14.792	10.192
880.28	1.404	0.0022305	24.674	11.360	984.25	1.403	0.0012996	16.075	10.160
882.77	1.404	0.0022457	24.912	11.328	987.36	1.403	0.0013214	16.395	10.128
884.02	1.404	0.0024519	27.239	11.312	988.92	1.403	0.0013699	17.024	10.112
885.27	1.404	0.0026521	29.504	11.296	993.64	1.403	0.0013793	17.222	10.064
886.52	1.404	0.0030007	33.429	11.280	998.40	1.403	0.0013647	17.121	10.016
887.78	1.404	0.0029031	32.388	11.264	1001.60	1.403	0.0013676	17.214	9.984
889.05	1.404	0.0031185	34.841	11.248	1006.44	1.403	0.0013926	17.612	9.936
890.31	1.404	0.0035350	39.549	11.232	1008.07	1.403	0.0013716	17.375	9.920
891.58	1.403	0.0035309	39.560	11.216	1009.69	1.403	0.0013157	16.694	9.904
894.13	1.403	0.0034924	39.240	11.184	1011.33	1.403	0.0012753	16.208	9.888
896.70	1.402	0.0034083	38.406	11.152	1014.61	1.403	0.0012396	15.804	9.856
899.28	1.402	0.0031472	35.566	11.120	1016.26	1.403	0.0011954	15.266	9.840
900.58	1.402	0.0030313	34.305	11.104	1019.58	1.403	0.0012342	15.813	9.808
901.88	1.402	0.0028004	31.738	11.088	1022.91	1.403	0.0012206	15.689	9.776
903.18	1.402	0.0024693	28.025	11.072	1024.59	1.403	0.0011662	15.016	9.760
904.49	1.402	0.0022902	26.030	11.056	1026.27	1.403	0.0011791	15.206	9.744
905.80	1.402	0.0023105	26.300	11.040	1034.77	1.404	0.0012859	16.721	9.664
907.11	1.402	0.0022216	25.324	11.024	1038.21	1.404	0.0012783	16.678	9.632
908.43	1.402	0.0021236	24.243	11.008	1039.93	1.404	0.0014120	18.453	9.616
909.75	1.402	0.0021149	24.178	10.992	1041.67	1.404	0.0014275	18.686	9.600
911.08	1.403	0.0022743	26.039	10.976	1045.15	1.404	0.0014322	18.810	9.568
912.41	1.403	0.0023252	26.660	10.960	1046.90	1.404	0.0014413	18.961	9.552
913.74	1.403	0.0023237	26.682	10.944	1048.66	1.404	0.0014254	18.783	9.536
915.08	1.403	0.0024580	28.265	10.928	1050.42	1.404	0.0016354	21.587	9.520
919.12	1.402	0.0025373	29.305	10.880	1052.19	1.404	0.0016296	21.547	9.504
920.47	1.402	0.0025332	29.302	10.864	1053.96	1.404	0.0016517	21.877	9.488
923.19	1.402	0.0025381	29.445	10.832	1055.74	1.404	0.0017769	23.574	9.472
924.56	1.402	0.0023915	27.786	10.816	1059.32	1.404	0.0019901	26.491	9.440
925.93	1.402	0.0023783	27.673	10.800	1061.12	1.404	0.0019361	25.817	9.424
928.68	1.402	0.0023539	27.470	10.768	1062.93	1.404	0.0020652	27.585	9.408
930.06	1.402	0.0021916	25.615	10.752	1064.74	1.404	0.0020639	27.614	9.392
931.45	1.402	0.0022543	26.387	10.736	1068.38	1.404	0.0022859	30.690	9.360
932.84	1.402	0.0020560	24.102	10.720	1072.04	1.404	0.0022261	29.989	9.328
934.23	1.402	0.0019641	23.058	10.704	1073.88	1.404	0.0023544	31.772	9.312
935.63	1.402	0.0019241	22.623	10.688	1079.45	1.404	0.0023444	31.801	9.264
937.03	1.402	0.0017665	20.800	10.672	1081.32	1.404	0.0028291	38.443	9.248

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1083.19	1.404	0.0029893	40.689	9.232	1215.95	1.405	0.0011156	17.046	8.224
1090.75	1.402	0.0031067	42.582	9.168	1218.32	1.405	0.0011012	16.859	8.208
1092.66	1.402	0.0022467	30.849	9.152	1220.70	1.405	0.0010812	16.586	8.192
1094.57	1.402	0.0020868	28.704	9.136	1223.09	1.405	0.0011465	17.622	8.176
1096.49	1.402	0.0016612	22.889	9.120	1225.49	1.405	0.0012616	19.429	8.160
1098.42	1.402	0.0012454	17.190	9.104	1227.90	1.405	0.0013433	20.727	8.144
1100.35	1.402	0.0010104	13.971	9.088	1230.32	1.405	0.0013281	20.533	8.128
1102.29	1.402	0.0009105	12.613	9.072	1232.74	1.406	0.0014061	21.782	8.112
1104.24	1.403	0.0008035	11.149	9.056	1235.18	1.406	0.0015568	24.164	8.096
1106.20	1.403	0.0007043	9.791	9.040	1237.62	1.406	0.0016580	25.787	8.080
1110.12	1.403	0.0006644	9.268	9.008	1240.08	1.406	0.0016832	26.230	8.064
1112.10	1.403	0.0006667	9.318	8.992	1242.55	1.406	0.0018338	28.633	8.048
1114.08	1.403	0.0006735	9.429	8.976	1245.02	1.406	0.0020231	31.653	8.032
1116.07	1.404	0.0007206	10.107	8.960	1247.51	1.405	0.0019775	31.001	8.016
1118.07	1.404	0.0008277	11.630	8.944	1250.00	1.405	0.0017432	27.382	8.000
1120.07	1.404	0.0009963	14.024	8.928	1252.51	1.405	0.0011536	18.158	7.984
1122.08	1.404	0.0011477	16.183	8.912	1255.02	1.406	0.0008411	13.265	7.968
1124.10	1.404	0.0013236	18.697	8.896	1257.55	1.406	0.0008780	13.876	7.952
1126.13	1.404	0.0015621	22.105	8.880	1260.08	1.407	0.0012219	19.348	7.936
1128.16	1.404	0.0019122	27.108	8.864	1262.63	1.407	0.0017310	27.464	7.920
1130.20	1.404	0.0020676	29.366	8.848	1265.18	1.407	0.0023286	37.021	7.904
1132.25	1.403	0.0019078	27.145	8.832	1267.75	1.407	0.0028571	45.517	7.888
1134.30	1.403	0.0016709	23.817	8.816	1270.33	1.406	0.0029247	46.688	7.872
1136.36	1.403	0.0016246	23.200	8.800	1272.91	1.406	0.0027440	43.892	7.856
1138.43	1.403	0.0014544	20.807	8.784	1275.51	1.406	0.0023633	37.880	7.840
1140.51	1.403	0.0013278	19.030	8.768	1278.12	1.406	0.0020089	32.266	7.824
1142.60	1.403	0.0012710	18.249	8.752	1280.74	1.407	0.0019087	30.719	7.808
1144.69	1.403	0.0012060	17.347	8.736	1283.37	1.407	0.0022800	36.770	7.792
1146.79	1.403	0.0010473	15.092	8.720	1286.01	1.408	0.0027902	45.091	7.776
1148.90	1.403	0.0009258	13.367	8.704	1288.66	1.408	0.0032695	52.946	7.760
1151.01	1.404	0.0008980	12.988	8.688	1291.32	1.407	0.0037201	60.366	7.744
1153.14	1.404	0.0008902	12.900	8.672	1294.00	1.407	0.0040877	66.469	7.728
1155.27	1.404	0.0008313	12.068	8.656	1296.68	1.406	0.0042277	68.889	7.712
1159.56	1.404	0.0008188	11.932	8.624	1299.38	1.406	0.0040393	65.956	7.696
1163.87	1.404	0.0008146	11.914	8.592	1302.08	1.406	0.0035938	58.804	7.680
1166.05	1.404	0.0008123	11.903	8.576	1304.80	1.406	0.0031756	52.068	7.664
1168.22	1.404	0.0008611	12.641	8.560	1307.53	1.406	0.0026323	43.251	7.648
1170.41	1.404	0.0009822	14.446	8.544	1310.27	1.407	0.0026714	43.986	7.632
1172.61	1.404	0.0010547	15.541	8.528	1313.03	1.407	0.0028256	46.622	7.616
1174.81	1.404	0.0011146	16.456	8.512	1315.79	1.407	0.0030364	50.206	7.600
1177.02	1.404	0.0012233	18.094	8.496	1318.57	1.407	0.0032774	54.306	7.584
1179.25	1.404	0.0013280	19.680	8.480	1321.35	1.407	0.0035091	58.268	7.568
1181.47	1.404	0.0013452	19.971	8.464	1324.15	1.407	0.0035576	59.198	7.552
1183.71	1.404	0.0012795	19.032	8.448	1326.96	1.407	0.0034676	57.822	7.536
1185.96	1.404	0.0012573	18.738	8.432	1329.79	1.407	0.0033290	55.630	7.520
1188.21	1.404	0.0012330	18.411	8.416	1332.62	1.407	0.0032446	54.335	7.504
1190.48	1.404	0.0011247	16.825	8.400	1335.47	1.407	0.0032277	54.168	7.488
1192.75	1.404	0.0010799	16.186	8.384	1338.33	1.407	0.0031048	52.216	7.472
1195.03	1.405	0.0011164	16.766	8.368	1341.20	1.408	0.0026195	44.150	7.456
1197.32	1.405	0.0011140	16.762	8.352	1346.98	1.409	0.0027689	46.869	7.424
1199.62	1.405	0.0011587	17.468	8.336	1349.89	1.410	0.0032935	55.868	7.408
1201.92	1.405	0.0012833	19.383	8.320	1352.81	1.410	0.0037172	63.192	7.392
1204.24	1.405	0.0013071	19.781	8.304	1355.75	1.411	0.0043637	74.343	7.376
1206.56	1.405	0.0013273	20.124	8.288	1358.70	1.412	0.0054628	93.271	7.360
1211.24	1.405	0.0012639	19.238	8.256	1361.66	1.412	0.0070079	119.914	7.344
1213.59	1.405	0.0011600	17.691	8.240	1364.63	1.412	0.0089449	153.391	7.328

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1367.62	1.411	0.0111186	191.084	7.312	1606.68	1.397	0.0004377	8.838	6.224
1370.61	1.409	0.0130743	225.186	7.296	1610.83	1.397	0.0004240	8.584	6.208
1373.63	1.406	0.0133568	230.560	7.280	1614.99	1.398	0.0004150	8.423	6.192
1376.65	1.402	0.0110799	191.676	7.264	1619.17	1.398	0.0004013	8.165	6.176
1379.69	1.401	0.0075250	130.466	7.248	1623.38	1.398	0.0003849	7.852	6.160
1382.74	1.403	0.0049003	85.148	7.232	1631.85	1.398	0.0003828	7.850	6.128
1385.81	1.404	0.0041002	71.404	7.216	1636.13	1.398	0.0003682	7.569	6.112
1388.89	1.405	0.0043269	75.519	7.200	1644.74	1.398	0.0003661	7.567	6.080
1391.98	1.406	0.0033545	58.678	7.184	1653.44	1.398	0.0003619	7.520	6.048
1395.09	1.407	0.0034181	59.924	7.168	1666.67	1.399	0.0003676	7.699	6.000
1398.21	1.408	0.0033089	58.139	7.152	1671.12	1.399	0.0003627	7.617	5.984
1401.35	1.409	0.0029883	52.624	7.136	1675.60	1.399	0.0003537	7.448	5.968
1404.49	1.410	0.0026944	47.555	7.120	1680.11	1.399	0.0003565	7.526	5.952
1407.66	1.412	0.0028537	50.480	7.104	1689.19	1.399	0.0003525	7.483	5.920
1410.84	1.413	0.0031359	55.598	7.088	1693.77	1.399	0.0003102	6.603	5.904
1414.03	1.415	0.0037863	67.279	7.072	1698.37	1.399	0.0003009	6.422	5.888
1417.23	1.419	0.0045120	80.356	7.056	1707.65	1.399	0.0002731	5.861	5.856
1420.46	1.420	0.0103104	184.041	7.040	1712.33	1.399	0.0002375	5.110	5.840
1423.69	1.419	0.0115730	207.048	7.024	1717.03	1.399	0.0002275	4.909	5.824
1426.94	1.420	0.0140121	251.257	7.008	1721.76	1.399	0.0002238	4.843	5.808
1430.21	1.420	0.0162021	291.192	6.992	1726.52	1.399	0.0002134	4.629	5.792
1433.49	1.420	0.0191757	345.427	6.976	1731.30	1.399	0.0002049	4.458	5.776
1436.78	1.420	0.0215443	388.985	6.960	1736.11	1.400	0.0002038	4.447	5.760
1440.09	1.419	0.0247080	447.133	6.944	1740.95	1.400	0.0001854	4.055	5.744
1443.42	1.419	0.0284869	516.710	6.928	1745.81	1.400	0.0001796	3.939	5.728
1446.76	1.418	0.0331616	602.895	6.912	1750.70	1.400	0.0001737	3.821	5.712
1450.12	1.415	0.0405248	738.472	6.896	1755.62	1.400	0.0001725	3.806	5.696
1453.49	1.407	0.0458197	836.902	6.880	1760.56	1.400	0.0001745	3.861	5.680
1456.88	1.397	0.0485001	887.925	6.864	1765.54	1.400	0.0001786	3.961	5.664
1460.28	1.385	0.0481942	884.383	6.848	1770.54	1.400	0.0001748	3.889	5.648
1463.70	1.374	0.0400019	735.772	6.832	1775.57	1.400	0.0001715	3.827	5.632
1467.14	1.369	0.0285120	525.664	6.816	1780.63	1.400	0.0001669	3.734	5.616
1470.59	1.369	0.0187990	347.404	6.800	1785.71	1.400	0.0001623	3.642	5.600
1474.06	1.371	0.0116535	215.864	6.784	1790.83	1.400	0.0001504	3.385	5.584
1477.54	1.375	0.0060158	111.697	6.768	1795.98	1.400	0.0001354	3.055	5.568
1481.04	1.380	0.0042283	78.693	6.752	1801.15	1.400	0.0001277	2.890	5.552
1484.56	1.383	0.0034044	63.512	6.736	1806.36	1.400	0.0001259	2.858	5.536
1491.65	1.386	0.0026741	50.125	6.704	1816.86	1.400	0.0001144	2.611	5.504
1495.22	1.388	0.0026344	49.499	6.688	1827.49	1.400	0.0001150	2.640	5.472
1498.80	1.388	0.0025432	47.900	6.672	1838.24	1.400	0.0001176	2.718	5.440
1502.40	1.389	0.0020291	38.308	6.656	1843.66	1.401	0.0001241	2.875	5.424
1516.99	1.392	0.0014905	28.414	6.592	1849.11	1.401	0.0001382	3.212	5.408
1520.68	1.392	0.0014698	28.088	6.576	1854.60	1.401	0.0001369	3.189	5.392
1524.39	1.392	0.0012741	24.406	6.560	1857.36	1.401	0.0001379	3.219	5.384
1528.12	1.393	0.0009913	19.035	6.544	1860.12	1.401	0.0001384	3.236	5.376
1531.86	1.393	0.0007882	15.174	6.528	1862.89	1.401	0.0001451	3.396	5.368
1550.87	1.395	0.0006884	13.415	6.448	1865.67	1.401	0.0001523	3.570	5.360
1570.35	1.396	0.0006438	12.704	6.368	1868.46	1.401	0.0001527	3.586	5.352
1574.31	1.396	0.0006109	12.087	6.352	1871.26	1.401	0.0001530	3.598	5.344
1578.28	1.396	0.0005910	11.721	6.336	1874.06	1.401	0.0001610	3.793	5.336
1582.28	1.397	0.0005523	10.981	6.320	1876.88	1.401	0.0001572	3.707	5.328
1586.29	1.397	0.0005266	10.497	6.304	1879.70	1.401	0.0001536	3.628	5.320
1590.33	1.397	0.0005230	10.452	6.288	1882.53	1.401	0.0001541	3.645	5.312
1594.39	1.397	0.0005014	10.046	6.272	1885.37	1.401	0.0001501	3.556	5.304
1598.47	1.397	0.0004740	9.521	6.256	1888.22	1.401	0.0001479	3.509	5.296
1602.56	1.397	0.0004490	9.042	6.240	1891.07	1.401	0.0001473	3.499	5.288

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1893.94	1.401	0.0001435	3.414	5.280	2097.32	1.402	0.0001581	4.167	4.768
1896.81	1.401	0.0001463	3.488	5.272	2100.84	1.402	0.0001589	4.195	4.760
1899.70	1.401	0.0001506	3.596	5.264	2104.38	1.402	0.0001604	4.242	4.752
1902.59	1.401	0.0001513	3.617	5.256	2107.93	1.402	0.0001637	4.337	4.744
1905.49	1.401	0.0001512	3.620	5.248	2111.49	1.402	0.0001653	4.386	4.736
1908.40	1.401	0.0001538	3.687	5.240	2115.06	1.402	0.0001665	4.426	4.728
1911.32	1.401	0.0001544	3.709	5.232	2118.64	1.402	0.0001695	4.513	4.720
1914.24	1.401	0.0001470	3.537	5.224	2122.24	1.402	0.0001772	4.727	4.712
1917.18	1.401	0.0001447	3.486	5.216	2125.85	1.402	0.0001857	4.962	4.704
1920.12	1.401	0.0001390	3.354	5.208	2129.47	1.402	0.0001929	5.163	4.696
1923.08	1.401	0.0001325	3.201	5.200	2133.11	1.402	0.0002093	5.611	4.688
1926.04	1.401	0.0001281	3.100	5.192	2136.75	1.402	0.0002242	6.021	4.680
1929.01	1.401	0.0001226	2.972	5.184	2140.41	1.402	0.0002350	6.321	4.672
1931.99	1.401	0.0001177	2.856	5.176	2144.08	1.402	0.0002440	6.574	4.664
1934.99	1.401	0.0001211	2.945	5.168	2147.77	1.402	0.0002514	6.786	4.656
1937.98	1.401	0.0001200	2.923	5.160	2151.46	1.402	0.0002575	6.962	4.648
1940.99	1.401	0.0001159	2.826	5.152	2155.17	1.402	0.0002569	6.957	4.640
1950.08	1.401	0.0001166	2.857	5.128	2158.90	1.402	0.0002557	6.937	4.632
1953.13	1.401	0.0001186	2.911	5.120	2162.63	1.402	0.0002579	7.008	4.624
1959.25	1.401	0.0001182	2.910	5.104	2166.38	1.402	0.0002568	6.990	4.616
1962.32	1.401	0.0001171	2.887	5.096	2170.14	1.402	0.0002515	6.857	4.608
1965.41	1.401	0.0001204	2.974	5.088	2173.91	1.402	0.0002526	6.901	4.600
1968.50	1.401	0.0001211	2.996	5.080	2177.70	1.402	0.0002523	6.906	4.592
1974.72	1.401	0.0001221	3.031	5.064	2181.50	1.402	0.0002512	6.887	4.584
1977.85	1.401	0.0001253	3.114	5.056	2185.32	1.402	0.0002495	6.853	4.576
1980.93	1.401	0.0001261	3.140	5.048	2189.14	1.402	0.0002483	6.831	4.568
1984.13	1.401	0.0001262	3.146	5.040	2192.98	1.402	0.0002488	6.857	4.560
1987.28	1.401	0.0001312	3.276	5.032	2196.84	1.402	0.0002504	6.912	4.552
1990.45	1.401	0.0001369	3.424	5.024	2200.70	1.403	0.0002477	6.850	4.544
1993.62	1.401	0.0001440	3.608	5.016	2204.59	1.403	0.0002485	6.884	4.536
1996.81	1.402	0.0001534	3.848	5.008	2208.48	1.403	0.0002516	6.983	4.528
2000.00	1.402	0.0001671	4.201	5.000	2212.39	1.403	0.0002507	6.971	4.520
2003.21	1.402	0.0001852	4.661	4.992	2216.31	1.403	0.0002522	7.023	4.512
2006.42	1.402	0.0002059	5.193	4.984	2220.25	1.403	0.0002563	7.152	4.504
2009.65	1.402	0.0002292	5.787	4.976	2224.20	1.403	0.0002583	7.220	4.496
2012.88	1.402	0.0002554	6.459	4.968	2228.16	1.403	0.0002625	7.350	4.488
2016.13	1.402	0.0002746	6.958	4.960	2232.14	1.403	0.0002650	7.434	4.480
2019.39	1.402	0.0002900	7.360	4.952	2236.14	1.403	0.0002669	7.500	4.472
2029.22	1.402	0.0002963	7.555	4.928	2240.14	1.403	0.0002698	7.595	4.464
2032.52	1.402	0.0002817	7.196	4.920	2244.17	1.403	0.0002724	7.681	4.456
2035.83	1.402	0.0002709	6.931	4.912	2248.20	1.403	0.0002752	7.776	4.448
2039.15	1.402	0.0002573	6.594	4.904	2252.25	1.403	0.0002775	7.854	4.440
2042.48	1.402	0.0002426	6.227	4.896	2256.32	1.403	0.0002812	7.973	4.432
2045.83	1.402	0.0002268	5.831	4.888	2260.40	1.403	0.0002838	8.060	4.424
2049.18	1.402	0.0002162	5.568	4.880	2264.49	1.403	0.0002843	8.091	4.416
2052.55	1.402	0.0002035	5.249	4.872	2268.60	1.403	0.0002873	8.189	4.408
2055.92	1.402	0.0001927	4.978	4.864	2272.73	1.403	0.0002892	8.260	4.400
2059.31	1.402	0.0001871	4.842	4.856	2276.87	1.403	0.0002917	8.345	4.392
2062.71	1.402	0.0001799	4.664	4.848	2281.02	1.403	0.0002963	8.493	4.384
2066.12	1.402	0.0001733	4.500	4.840	2285.19	1.403	0.0003031	8.703	4.376
2069.54	1.402	0.0001694	4.405	4.832	2289.38	1.403	0.0003151	9.065	4.368
2072.97	1.402	0.0001673	4.357	4.824	2293.58	1.403	0.0003236	9.326	4.360
2076.41	1.402	0.0001607	4.194	4.816	2297.79	1.403	0.0003303	9.538	4.352
2083.33	1.402	0.0001558	4.079	4.800	2302.03	1.403	0.0003384	9.789	4.344
2086.81	1.402	0.0001532	4.018	4.792	2306.27	1.403	0.0003471	10.059	4.336
2093.80	1.402	0.0001540	4.051	4.776	2310.54	1.403	0.0003556	10.326	4.328

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2314.82	1.403	0.0003591	10.447	4.320	2593.36	1.407	0.0008403	27.384	3.856
2319.11	1.403	0.0003653	10.647	4.312	2598.75	1.407	0.0008823	28.815	3.848
2323.42	1.403	0.0003676	10.734	4.304	2604.17	1.407	0.0009204	30.120	3.840
2327.75	1.403	0.0003606	10.549	4.296	2609.60	1.407	0.0009560	31.350	3.832
2332.09	1.403	0.0003612	10.585	4.288	2615.06	1.407	0.0009951	32.701	3.824
2340.82	1.403	0.0003554	10.453	4.272	2620.55	1.407	0.0010271	33.822	3.816
2345.22	1.403	0.0003547	10.452	4.264	2626.05	1.408	0.0010625	35.064	3.808
2349.62	1.403	0.0003510	10.363	4.256	2631.58	1.408	0.0011245	37.186	3.800
2354.05	1.403	0.0003465	10.249	4.248	2637.13	1.408	0.0012019	39.830	3.792
2358.49	1.403	0.0003463	10.264	4.240	2642.71	1.408	0.0012786	42.462	3.784
2362.95	1.404	0.0003539	10.509	4.232	2648.31	1.408	0.0013357	44.452	3.776
2367.42	1.404	0.0003455	10.279	4.224	2653.93	1.408	0.0013896	46.344	3.768
2371.92	1.404	0.0003491	10.406	4.216	2659.57	1.408	0.0014511	48.498	3.760
2376.43	1.404	0.0003466	10.351	4.208	2665.25	1.409	0.0014661	49.103	3.752
2380.95	1.404	0.0003413	10.210	4.200	2670.94	1.409	0.0014405	48.350	3.744
2385.50	1.404	0.0003415	10.237	4.192	2676.66	1.409	0.0014038	47.217	3.736
2390.06	1.404	0.0003357	10.081	4.184	2682.40	1.409	0.0013734	46.295	3.728
2394.64	1.404	0.0003328	10.015	4.176	2688.17	1.409	0.0013566	45.827	3.720
2399.23	1.404	0.0003262	9.835	4.168	2693.97	1.410	0.0013584	45.987	3.712
2403.85	1.404	0.0003196	9.654	4.160	2699.78	1.410	0.0013880	47.090	3.704
2408.48	1.404	0.0003163	9.572	4.152	2705.63	1.410	0.0014333	48.733	3.696
2413.13	1.404	0.0003106	9.419	4.144	2711.50	1.411	0.0015112	51.493	3.688
2417.80	1.404	0.0003038	9.229	4.136	2717.39	1.411	0.0016052	54.815	3.680
2422.48	1.404	0.0002977	9.064	4.128	2723.31	1.411	0.0016183	55.380	3.672
2427.18	1.404	0.0002921	8.908	4.120	2729.26	1.412	0.0016298	55.898	3.664
2431.91	1.404	0.0002851	8.711	4.112	2735.23	1.412	0.0016638	57.188	3.656
2436.65	1.404	0.0002753	8.431	4.104	2741.23	1.413	0.0016609	57.213	3.648
2441.41	1.404	0.0002654	8.143	4.096	2747.25	1.413	0.0016535	57.084	3.640
2446.18	1.404	0.0002566	7.889	4.088	2753.30	1.414	0.0016816	58.183	3.632
2450.98	1.404	0.0002475	7.623	4.080	2759.38	1.415	0.0017776	61.638	3.624
2455.80	1.404	0.0002413	7.445	4.072	2765.49	1.415	0.0019698	68.453	3.616
2460.63	1.405	0.0002357	7.289	4.064	2771.62	1.416	0.0022423	78.096	3.608
2465.48	1.405	0.0002344	7.261	4.056	2777.78	1.417	0.0026190	91.420	3.600
2470.36	1.405	0.0002383	7.398	4.048	2783.96	1.418	0.0032129	112.402	3.592
2475.25	1.405	0.0002432	7.566	4.040	2790.18	1.420	0.0035614	124.871	3.584
2480.16	1.405	0.0002509	7.821	4.032	2796.42	1.421	0.0041170	144.675	3.576
2485.09	1.405	0.0002665	8.322	4.024	2802.69	1.422	0.0048081	169.341	3.568
2490.04	1.405	0.0002817	8.814	4.016	2808.99	1.424	0.0055772	196.869	3.560
2495.01	1.405	0.0003000	9.405	4.008	2815.32	1.427	0.0064872	229.506	3.552
2500.00	1.405	0.0003221	10.121	4.000	2821.67	1.430	0.0095079	337.132	3.544
2505.01	1.405	0.0003394	10.683	3.992	2828.05	1.433	0.0131563	467.554	3.536
2510.04	1.405	0.0003640	11.482	3.984	2834.47	1.434	0.0193230	688.267	3.528
2515.09	1.405	0.0003898	12.320	3.976	2840.91	1.434	0.0244318	872.214	3.520
2520.16	1.405	0.0004128	13.072	3.968	2847.38	1.432	0.0295268	1056.507	3.512
2525.25	1.406	0.0004325	13.725	3.960	2853.88	1.428	0.0340205	1220.076	3.504
2530.36	1.406	0.0004540	14.437	3.952	2860.41	1.424	0.0361765	1300.364	3.496
2535.50	1.406	0.0004735	15.087	3.944	2866.97	1.420	0.0364781	1314.213	3.488
2540.65	1.406	0.0004921	15.712	3.936	2873.56	1.418	0.0360492	1301.746	3.480
2545.83	1.406	0.0005128	16.404	3.928	2880.18	1.418	0.0364951	1320.881	3.472
2551.02	1.406	0.0005450	17.470	3.920	2886.84	1.418	0.0383283	1390.438	3.464
2556.24	1.406	0.0005764	18.517	3.912	2893.52	1.418	0.0420405	1528.636	3.456
2561.48	1.406	0.0006200	19.958	3.904	2900.23	1.417	0.0471720	1719.202	3.448
2572.02	1.406	0.0006032	19.496	3.888	2906.98	1.413	0.0540529	1974.563	3.440
2577.32	1.407	0.0006688	21.661	3.880	2913.75	1.405	0.0605133	2215.709	3.432
2582.65	1.407	0.0007295	23.676	3.872	2920.56	1.392	0.0636977	2337.760	3.424
2587.99	1.407	0.0007923	25.767	3.864	2927.40	1.378	0.0595081	2189.113	3.416

DECANE					DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2934.27	1.368	0.0487597	1797.922	3.408	3378.38	1.396	0.0001445	6.133	2.960
2941.18	1.364	0.0387573	1432.467	3.400	3387.53	1.396	0.0001380	5.876	2.952
2948.11	1.362	0.0299108	1108.105	3.392	3396.74	1.396	0.0001305	5.568	2.944
2955.08	1.363	0.0229081	850.685	3.384	3406.00	1.396	0.0001257	5.380	2.936
2962.09	1.365	0.0173278	644.986	3.376	3415.30	1.396	0.0001202	5.157	2.928
2969.12	1.366	0.0124417	464.214	3.368	3424.66	1.397	0.0001103	4.748	2.920
2976.19	1.369	0.0077123	288.440	3.360	3434.07	1.397	0.0001011	4.362	2.912
2983.29	1.373	0.0055145	206.734	3.352	3443.53	1.397	0.0000927	4.010	2.904
2990.43	1.376	0.0045970	172.749	3.344	3453.04	1.397	0.0000826	3.586	2.896
2997.60	1.378	0.0038331	144.389	3.336	3462.60	1.397	0.0000746	3.247	2.888
3004.81	1.379	0.0031406	118.589	3.328	3472.22	1.397	0.0000680	2.966	2.880
3012.05	1.381	0.0026359	99.772	3.320	3481.89	1.397	0.0000628	2.748	2.872
3019.32	1.382	0.0022239	84.379	3.312	3491.62	1.397	0.0000598	2.622	2.864
3026.63	1.383	0.0019065	72.510	3.304	3511.24	1.397	0.0000594	2.622	2.848
3033.98	1.384	0.0016106	61.405	3.296	3521.13	1.397	0.0000620	2.741	2.840
3041.36	1.385	0.0013661	52.211	3.288	3531.07	1.397	0.0000699	3.102	2.832
3048.78	1.386	0.0011878	45.507	3.280	3541.08	1.397	0.0000784	3.488	2.824
3056.24	1.387	0.0010460	40.173	3.272	3551.14	1.398	0.0000928	4.142	2.816
3063.73	1.387	0.0009228	35.526	3.264	3561.25	1.398	0.0001093	4.889	2.808
3071.25	1.388	0.0008139	31.413	3.256	3571.43	1.398	0.0001276	5.727	2.800
3078.82	1.389	0.0007335	28.380	3.248	3581.66	1.398	0.0001473	6.631	2.792
3086.42	1.389	0.0006801	26.377	3.240	3591.95	1.398	0.0001460	6.591	2.784
3094.06	1.390	0.0006197	24.095	3.232	3602.31	1.398	0.0001685	7.626	2.776
3101.74	1.390	0.0005911	23.039	3.224	3612.72	1.398	0.0001856	8.425	2.768
3109.45	1.391	0.0005499	21.488	3.216	3623.19	1.398	0.0001957	8.911	2.760
3117.21	1.391	0.0005361	20.999	3.208	3633.72	1.398	0.0002064	9.427	2.752
3125.00	1.391	0.0005286	20.758	3.200	3644.32	1.398	0.0002029	9.291	2.744
3132.83	1.392	0.0005209	20.506	3.192	3654.97	1.398	0.0002000	9.188	2.736
3140.70	1.392	0.0005083	20.060	3.184	3665.69	1.398	0.0001969	9.071	2.728
3148.62	1.392	0.0005160	20.415	3.176	3676.47	1.398	0.0001948	8.999	2.720
3156.57	1.392	0.0005003	19.844	3.168	3687.32	1.398	0.0001900	8.804	2.712
3164.56	1.393	0.0004883	19.418	3.160	3698.23	1.398	0.0001910	8.876	2.704
3172.59	1.393	0.0004639	18.496	3.152	3709.20	1.398	0.0001922	8.959	2.696
3180.66	1.393	0.0004364	17.441	3.144	3720.24	1.398	0.0001931	9.026	2.688
3188.78	1.393	0.0003999	16.023	3.136	3731.34	1.398	0.0001972	9.247	2.680
3196.93	1.393	0.0003565	14.322	3.128	3742.52	1.398	0.0002011	9.459	2.672
3205.13	1.394	0.0003524	14.193	3.120	3753.75	1.398	0.0002022	9.536	2.664
3213.37	1.394	0.0003156	12.744	3.112	3765.06	1.398	0.0002055	9.725	2.656
3221.65	1.394	0.0002800	11.335	3.104	3776.44	1.398	0.0002081	9.874	2.648
3229.97	1.394	0.0002519	10.225	3.096	3787.88	1.398	0.0002109	10.039	2.640
3238.34	1.394	0.0002275	9.257	3.088	3799.39	1.398	0.0002112	10.085	2.632
3246.75	1.394	0.0002093	8.541	3.080	3810.98	1.398	0.0002137	10.233	2.624
3255.21	1.395	0.0001946	7.959	3.072	3822.63	1.399	0.0002182	10.480	2.616
3263.71	1.395	0.0001825	7.485	3.064	3834.36	1.399	0.0002197	10.586	2.608
3272.25	1.395	0.0001715	7.053	3.056	3846.15	1.399	0.0002180	10.538	2.600
3280.84	1.395	0.0001664	6.860	3.048	3858.03	1.399	0.0002187	10.604	2.592
3289.47	1.395	0.0001634	6.753	3.040	3869.97	1.399	0.0002203	10.711	2.584
3298.15	1.395	0.0001587	6.577	3.032	3881.99	1.399	0.0002192	10.692	2.576
3306.88	1.395	0.0001564	6.500	3.024	3894.08	1.399	0.0002233	10.928	2.568
3315.65	1.396	0.0001544	6.434	3.016	3906.25	1.399	0.0002236	10.976	2.560
3324.47	1.396	0.0001555	6.495	3.008	4000.00	1.399	0.0003850	19.350	2.500
3333.33	1.396	0.0001552	6.500	3.000	4090.00	1.399	0.0005781	29.710	2.445
3342.25	1.396	0.0001548	6.503	2.992	4337.00	1.399	0.0007182	39.140	2.306
3351.21	1.396	0.0001526	6.425	2.984	4390.00	1.399	0.0003990	22.010	2.278
3360.22	1.396	0.0001501	6.338	2.976	4473.00	1.399	0.0001244	6.990	2.236
3369.27	1.396	0.0001486	6.292	2.968	4615.00	1.399	0.0000526	3.050	2.167

DECANE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
4737.00	1.400	0.0000242	1.440	2.111
4800.00	1.400	0.0000239	1.440	2.083
4900.00	1.400	0.0000234	1.440	2.041
5000.00	1.400	0.0000229	1.440	2.000

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
400.00	1.386	0.0013261	6.666	25.000	727.59	1.392	0.0118597	108.436	13.744
416.67	1.386	0.0012731	6.666	24.000	729.29	1.391	0.0125184	114.726	13.712
434.78	1.387	0.0012790	6.988	23.000	730.14	1.390	0.0135475	124.301	13.696
443.46	1.388	0.0013730	7.651	22.550	730.99	1.389	0.0135837	124.778	13.680
451.16	1.388	0.0020443	11.590	22.165	731.85	1.388	0.0142805	131.333	13.664
454.55	1.388	0.0023708	13.542	22.000	733.57	1.386	0.0141914	130.820	13.632
461.68	1.388	0.0030743	17.836	21.660	735.29	1.385	0.0131251	121.275	13.600
465.22	1.387	0.0033113	19.358	21.495	737.03	1.384	0.0125809	116.522	13.568
468.82	1.387	0.0030274	17.836	21.330	737.90	1.383	0.0124763	115.690	13.552
474.95	1.384	0.0036889	22.017	21.055	740.52	1.382	0.0116157	108.092	13.504
476.19	1.385	0.0019753	11.820	21.000	742.28	1.381	0.0101817	94.973	13.472
487.92	1.387	0.0015782	9.676	20.495	743.16	1.381	0.0100087	93.470	13.456
500.00	1.388	0.0013010	8.175	20.000	744.93	1.379	0.0090829	85.025	13.424
504.41	1.388	0.0012618	7.998	19.825	745.82	1.379	0.0076112	71.334	13.408
511.51	1.389	0.0012443	7.998	19.550	746.71	1.379	0.0072206	67.754	13.392
517.33	1.390	0.0013129	8.535	19.330	747.61	1.379	0.0063642	59.790	13.376
520.29	1.390	0.0014499	9.479	19.220	748.50	1.380	0.0061023	57.398	13.360
526.32	1.391	0.0018952	12.535	19.000	749.40	1.379	0.0054978	51.774	13.344
537.49	1.392	0.0032597	22.017	18.605	750.30	1.380	0.0043366	40.888	13.328
545.55	1.393	0.0059180	40.572	18.330	752.11	1.381	0.0033758	31.905	13.296
550.51	1.392	0.0093705	64.824	18.165	758.50	1.383	0.0029619	28.232	13.184
553.02	1.390	0.0098679	68.576	18.083	759.42	1.383	0.0029085	27.756	13.168
555.56	1.387	0.0092853	64.824	18.000	764.99	1.384	0.0027624	26.555	13.072
561.01	1.386	0.0057549	40.572	17.825	766.87	1.384	0.0024862	23.959	13.040
566.25	1.387	0.0039371	28.015	17.660	767.81	1.384	0.0021305	20.557	13.024
577.03	1.389	0.0030406	22.048	17.330	768.76	1.385	0.0019469	18.808	13.008
588.24	1.392	0.0037899	28.015	17.000	777.36	1.388	0.0018342	17.918	12.864
598.27	1.394	0.0053965	40.572	16.715	778.33	1.388	0.0022434	21.942	12.848
606.24	1.396	0.0070897	54.011	16.495	779.30	1.389	0.0025017	24.499	12.832
614.44	1.398	0.0120288	92.877	16.275	780.27	1.389	0.0029364	28.792	12.816
625.00	1.394	0.0212120	166.598	16.000	781.25	1.389	0.0034131	33.508	12.800
628.63	1.390	0.0236877	187.124	15.908	782.23	1.389	0.0038563	37.907	12.784
634.12	1.382	0.0244146	194.550	15.770	783.21	1.389	0.0038396	37.790	12.768
635.22	1.381	0.0234420	187.124	15.743	784.19	1.389	0.0045534	44.871	12.752
652.32	1.373	0.0113302	92.877	15.330	785.18	1.388	0.0048566	47.919	12.736
666.67	1.376	0.0011318	9.482	15.000	787.15	1.388	0.0049648	49.110	12.704
677.97	1.381	0.0008202	6.988	14.750	788.15	1.387	0.0051270	50.779	12.688
689.66	1.384	0.0006626	5.742	14.500	789.14	1.387	0.0048009	47.609	12.672
693.64	1.385	0.0006250	5.448	14.417	790.14	1.387	0.0045924	45.599	12.656
701.75	1.387	0.0006851	6.041	14.250	791.14	1.387	0.0046839	46.566	12.640
714.29	1.391	0.0020860	18.724	14.000	792.14	1.386	0.0042854	42.658	12.624
715.10	1.392	0.0026450	23.769	13.984	793.15	1.386	0.0036279	36.159	12.608
716.74	1.392	0.0029232	26.329	13.952	794.16	1.386	0.0033753	33.684	12.592
718.39	1.392	0.0036829	33.248	13.920	795.17	1.386	0.0030850	30.827	12.576
719.22	1.393	0.0040079	36.224	13.904	796.18	1.386	0.0023399	23.411	12.560
720.05	1.393	0.0046070	41.686	13.888	797.19	1.387	0.0019476	19.510	12.544
720.88	1.393	0.0055847	50.591	13.872	798.21	1.387	0.0018001	18.056	12.528
721.71	1.393	0.0057027	51.719	13.856	805.41	1.390	0.0017530	17.742	12.416
723.38	1.394	0.0069903	63.544	13.824	806.45	1.391	0.0021927	22.221	12.400
724.22	1.394	0.0085736	78.026	13.808	807.49	1.391	0.0028310	28.727	12.384
725.06	1.394	0.0097901	89.202	13.792	808.54	1.391	0.0031019	31.516	12.368
725.90	1.393	0.0098099	89.485	13.776	809.59	1.391	0.0034996	35.604	12.352
726.74	1.393	0.0112834	103.045	13.760	810.64	1.391	0.0040835	41.598	12.336
					811.69	1.391	0.0042713	43.568	12.320
					812.74	1.391	0.0042590	43.498	12.304
					813.80	1.390	0.0047109	48.176	12.288

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
814.86	1.390	0.0046855	47.978	12.272	882.77	1.416	0.0122811	136.237	11.328
815.93	1.390	0.0043385	44.484	12.256	884.02	1.418	0.0132053	146.696	11.312
816.99	1.390	0.0043083	44.232	12.240	885.27	1.419	0.0150905	167.876	11.296
818.06	1.389	0.0041450	42.610	12.224	886.52	1.421	0.0155550	173.288	11.280
819.14	1.389	0.0036592	37.667	12.208	887.78	1.423	0.0171764	191.623	11.264
820.21	1.389	0.0032693	33.697	12.192	889.05	1.426	0.0200547	224.054	11.248
821.29	1.390	0.0027102	27.971	12.176	890.31	1.427	0.0235182	263.121	11.232
822.37	1.390	0.0026984	27.886	12.160	891.58	1.428	0.0263839	295.603	11.216
823.45	1.390	0.0020194	20.896	12.144	892.86	1.429	0.0293127	328.889	11.200
825.63	1.391	0.0019701	20.440	12.112	894.13	1.430	0.0323532	363.519	11.184
826.72	1.391	0.0019264	20.013	12.096	895.42	1.432	0.0352049	396.132	11.168
827.81	1.392	0.0019083	19.851	12.080	896.70	1.435	0.0406439	457.986	11.152
828.91	1.392	0.0022144	23.066	12.064	899.28	1.435	0.0538226	608.233	11.120
830.01	1.393	0.0023238	24.238	12.048	900.58	1.437	0.0587810	665.226	11.104
831.12	1.393	0.0024744	25.843	12.032	901.88	1.436	0.0720336	816.382	11.088
832.22	1.393	0.0027015	28.252	12.016	903.18	1.432	0.0806800	915.693	11.072
833.33	1.393	0.0027949	29.268	12.000	907.11	1.388	0.1187587	1353.740	11.024
834.45	1.393	0.0030569	32.054	11.984	911.08	1.344	0.0785470	899.283	10.976
835.56	1.393	0.0031472	33.046	11.968	913.74	1.342	0.0584526	671.176	10.944
836.68	1.394	0.0030930	32.520	11.952	915.08	1.341	0.0546242	628.136	10.928
837.80	1.394	0.0032296	34.001	11.936	916.42	1.341	0.0443943	511.248	10.912
838.93	1.394	0.0032228	33.976	11.920	917.77	1.343	0.0418904	483.124	10.896
840.05	1.394	0.0032356	34.156	11.904	919.12	1.344	0.0357133	412.489	10.880
841.18	1.394	0.0031368	33.158	11.888	920.47	1.346	0.0324005	374.775	10.864
843.45	1.394	0.0028457	30.161	11.856	921.83	1.347	0.0299066	346.439	10.848
844.59	1.394	0.0026266	27.877	11.840	923.19	1.348	0.0261048	302.846	10.832
845.74	1.395	0.0021840	23.211	11.824	924.56	1.350	0.0241732	280.854	10.816
846.88	1.395	0.0021783	23.182	11.808	925.93	1.351	0.0212775	247.576	10.800
848.03	1.396	0.0019979	21.291	11.792	927.30	1.353	0.0193846	225.885	10.784
850.34	1.397	0.0019032	20.337	11.760	928.68	1.354	0.0179856	209.894	10.768
851.50	1.398	0.0017577	18.808	11.744	930.06	1.355	0.0158414	185.146	10.752
852.66	1.398	0.0017771	19.041	11.728	931.45	1.357	0.0143639	168.129	10.736
853.83	1.399	0.0019876	21.326	11.712	932.84	1.358	0.0133625	156.640	10.720
854.99	1.400	0.0020373	21.889	11.696	934.23	1.359	0.0116163	136.374	10.704
856.16	1.400	0.0024709	26.584	11.680	935.63	1.361	0.0103507	121.698	10.688
857.34	1.401	0.0028067	30.239	11.664	937.03	1.362	0.0089566	105.464	10.672
858.52	1.402	0.0030499	32.904	11.648	938.44	1.364	0.0082949	97.820	10.656
859.70	1.402	0.0036359	39.279	11.632	939.85	1.365	0.0073727	87.076	10.640
860.88	1.403	0.0038815	41.991	11.616	941.27	1.367	0.0065534	77.515	10.624
862.07	1.403	0.0042357	45.886	11.600	942.68	1.369	0.0061829	73.243	10.608
863.26	1.404	0.0045103	48.928	11.584	944.11	1.370	0.0056968	67.587	10.592
864.45	1.404	0.0047493	51.592	11.568	945.54	1.372	0.0053022	63.000	10.576
865.65	1.405	0.0049696	54.060	11.552	946.97	1.373	0.0052982	63.048	10.560
866.85	1.405	0.0053542	58.324	11.536	948.41	1.375	0.0052229	62.247	10.544
868.06	1.406	0.0053294	58.135	11.520	951.29	1.377	0.0050631	60.526	10.512
869.26	1.407	0.0055930	61.094	11.504	952.74	1.379	0.0049438	59.190	10.496
870.47	1.408	0.0068761	75.215	11.488	954.20	1.380	0.0052143	62.524	10.480
871.69	1.409	0.0078620	86.120	11.472	955.66	1.382	0.0053719	64.512	10.464
872.91	1.409	0.0085841	94.162	11.456	957.12	1.383	0.0054862	65.986	10.448
874.13	1.409	0.0086230	94.721	11.440	958.59	1.385	0.0058048	69.925	10.432
875.35	1.410	0.0092220	101.442	11.424	960.06	1.387	0.0062641	75.573	10.416
876.58	1.411	0.0099965	110.115	11.408	961.54	1.388	0.0069432	83.895	10.400
877.81	1.411	0.0098841	109.030	11.392	963.02	1.390	0.0074233	89.834	10.384
879.04	1.412	0.0105786	116.855	11.376	964.51	1.393	0.0079646	96.534	10.368
880.28	1.413	0.0111466	123.303	11.360	966.00	1.395	0.0110443	134.069	10.352
881.52	1.415	0.0118325	131.075	11.344	967.49	1.396	0.0111668	135.764	10.336

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
968.99	1.402	0.0129970	158.261	10.320	1075.73	1.368	0.0018111	24.482	9.296
970.50	1.402	0.0222636	271.519	10.304	1077.59	1.369	0.0018316	24.802	9.280
973.52	1.398	0.0259147	317.030	10.272	1079.45	1.369	0.0017956	24.357	9.264
975.04	1.398	0.0269322	329.992	10.256	1081.32	1.370	0.0018149	24.662	9.248
976.56	1.398	0.0293028	359.598	10.240	1083.19	1.370	0.0021121	28.750	9.232
978.09	1.398	0.0298953	367.444	10.224	1085.07	1.371	0.0022919	31.251	9.216
979.62	1.399	0.0334414	411.672	10.208	1086.96	1.372	0.0028777	39.307	9.200
981.16	1.400	0.0339673	418.805	10.192	1088.85	1.372	0.0035839	49.039	9.184
982.70	1.402	0.0405948	501.305	10.176	1090.75	1.372	0.0039281	53.842	9.168
984.25	1.401	0.0455594	563.499	10.160	1092.66	1.372	0.0046930	64.438	9.152
985.80	1.401	0.0529951	656.499	10.144	1094.57	1.371	0.0049145	67.597	9.136
987.36	1.395	0.0630772	782.632	10.128	1096.49	1.371	0.0051599	71.098	9.120
988.92	1.387	0.0664471	825.747	10.112	1098.42	1.370	0.0054997	75.913	9.104
990.49	1.374	0.0751969	935.965	10.096	1100.35	1.370	0.0050161	69.360	9.088
992.06	1.361	0.0671113	836.650	10.080	1102.29	1.369	0.0049046	67.937	9.072
993.64	1.354	0.0625968	781.612	10.064	1104.24	1.369	0.0039301	54.535	9.056
995.22	1.348	0.0552609	691.110	10.048	1106.20	1.369	0.0031634	43.974	9.040
996.81	1.346	0.0486480	609.379	10.032	1108.16	1.369	0.0026431	36.806	9.024
998.40	1.344	0.0450809	565.597	10.016	1110.12	1.370	0.0022689	31.651	9.008
1000.00	1.344	0.0383556	481.991	10.000	1112.10	1.370	0.0023645	33.043	8.992
1001.60	1.345	0.0373840	470.533	9.984	1114.08	1.371	0.0025664	35.929	8.976
1003.21	1.343	0.0346766	437.158	9.968	1116.07	1.371	0.0026643	37.366	8.960
1004.82	1.343	0.0320099	404.187	9.952	1118.07	1.371	0.0025220	35.434	8.944
1008.07	1.332	0.0304114	385.245	9.920	1120.07	1.371	0.0024546	34.549	8.928
1009.69	1.332	0.0122054	154.864	9.904	1122.08	1.371	0.0022000	31.021	8.912
1012.97	1.345	0.0086485	110.090	9.872	1124.10	1.371	0.0017952	25.358	8.896
1014.61	1.349	0.0083652	106.656	9.856	1126.13	1.371	0.0016475	23.314	8.880
1016.26	1.351	0.0082454	105.299	9.840	1130.20	1.372	0.0016310	23.165	8.848
1017.92	1.353	0.0087389	111.784	9.824	1132.25	1.373	0.0021645	30.797	8.832
1021.24	1.355	0.0087216	111.927	9.792	1134.30	1.373	0.0026034	37.108	8.816
1022.91	1.355	0.0082439	105.970	9.776	1136.36	1.373	0.0027984	39.961	8.800
1026.27	1.356	0.0078914	101.771	9.744	1142.60	1.372	0.0029726	42.682	8.752
1027.96	1.357	0.0069364	89.602	9.728	1144.69	1.372	0.0027493	39.547	8.736
1029.65	1.357	0.0070020	90.598	9.712	1146.79	1.371	0.0022755	32.792	8.720
1031.35	1.358	0.0064807	83.992	9.696	1148.90	1.372	0.0016686	24.091	8.704
1033.06	1.358	0.0059955	77.832	9.680	1151.01	1.372	0.0013508	19.539	8.688
1034.77	1.358	0.0055206	71.787	9.664	1153.14	1.372	0.0011328	16.415	8.672
1036.48	1.359	0.0043253	56.337	9.648	1159.56	1.373	0.0011279	16.435	8.624
1038.21	1.360	0.0038932	50.793	9.632	1161.71	1.374	0.0012975	18.941	8.608
1045.15	1.362	0.0039362	51.697	9.568	1163.87	1.374	0.0015957	23.338	8.592
1046.90	1.362	0.0038235	50.300	9.552	1166.05	1.374	0.0018513	27.127	8.576
1048.66	1.363	0.0030253	39.867	9.536	1168.22	1.374	0.0017906	26.287	8.560
1050.42	1.363	0.0026409	34.860	9.520	1170.41	1.373	0.0016232	23.874	8.544
1052.19	1.364	0.0023298	30.805	9.504	1172.61	1.373	0.0013791	20.322	8.528
1053.96	1.365	0.0022251	29.470	9.488	1174.81	1.374	0.0008818	13.018	8.512
1055.74	1.365	0.0023447	31.106	9.472	1188.21	1.375	0.0009893	14.772	8.416
1057.53	1.366	0.0021378	28.410	9.456	1190.48	1.376	0.0013645	20.413	8.400
1059.32	1.367	0.0025176	33.514	9.440	1192.75	1.376	0.0015491	23.218	8.384
1061.12	1.367	0.0026880	35.843	9.424	1195.03	1.375	0.0015880	23.847	8.368
1062.93	1.367	0.0031216	41.696	9.408	1197.32	1.375	0.0014637	22.022	8.352
1064.74	1.367	0.0035422	47.394	9.392	1199.62	1.375	0.0011858	17.876	8.336
1066.55	1.367	0.0034047	45.633	9.376	1201.92	1.376	0.0010185	15.384	8.320
1068.38	1.367	0.0035725	47.964	9.360	1204.24	1.376	0.0010610	16.056	8.304
1070.21	1.367	0.0030704	41.293	9.344	1206.56	1.376	0.0011290	17.118	8.288
1072.04	1.367	0.0027150	36.575	9.328	1208.90	1.377	0.0014040	21.328	8.272
1073.88	1.368	0.0022986	31.019	9.312	1211.24	1.377	0.0018167	27.652	8.256

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1213.59	1.377	0.0020040	30.561	8.240	1379.69	1.378	0.0073963	128.235	7.248
1215.95	1.376	0.0021395	32.691	8.224	1382.74	1.379	0.0053203	92.446	7.232
1218.32	1.376	0.0021993	33.671	8.208	1385.81	1.380	0.0044143	76.873	7.216
1220.70	1.376	0.0021904	33.601	8.192	1388.89	1.381	0.0040701	71.037	7.200
1223.09	1.376	0.0019250	29.586	8.176	1391.98	1.382	0.0035154	61.492	7.184
1225.49	1.376	0.0016262	25.043	8.160	1395.09	1.383	0.0032876	57.636	7.168
1227.90	1.376	0.0013438	20.735	8.144	1398.21	1.384	0.0037041	65.082	7.152
1230.32	1.377	0.0010953	16.934	8.128	1401.35	1.386	0.0042736	75.257	7.136
1232.74	1.377	0.0011481	17.786	8.112	1404.49	1.387	0.0062347	110.038	7.120
1235.18	1.378	0.0015266	23.696	8.096	1407.66	1.388	0.0075130	132.899	7.104
1237.62	1.378	0.0021432	33.332	8.080	1410.84	1.388	0.0088165	156.309	7.088
1240.08	1.378	0.0028662	44.665	8.064	1414.03	1.387	0.0095347	169.425	7.072
1242.55	1.377	0.0032758	51.150	8.048	1417.23	1.388	0.0093035	165.690	7.056
1245.02	1.376	0.0030888	48.326	8.032	1420.46	1.389	0.0102037	182.137	7.040
1247.51	1.376	0.0024650	38.643	8.016	1423.69	1.392	0.0116073	207.662	7.024
1250.00	1.376	0.0017998	28.272	8.000	1426.94	1.393	0.0172324	309.002	7.008
1252.51	1.377	0.0011451	18.023	7.984	1430.21	1.391	0.0203295	365.373	6.992
1262.63	1.378	0.0012583	19.965	7.920	1433.49	1.389	0.0232985	419.693	6.976
1265.18	1.379	0.0017477	27.787	7.904	1436.78	1.386	0.0246507	445.071	6.960
1267.75	1.379	0.0019757	31.475	7.888	1440.09	1.384	0.0247703	448.261	6.944
1270.33	1.378	0.0019819	31.638	7.872	1443.42	1.384	0.0262925	476.908	6.928
1272.91	1.379	0.0019412	31.052	7.856	1446.76	1.383	0.0303188	551.212	6.912
1275.51	1.379	0.0019193	30.764	7.840	1450.12	1.378	0.0341626	622.537	6.896
1278.12	1.379	0.0019388	31.139	7.824	1453.49	1.372	0.0348340	636.246	6.880
1280.74	1.379	0.0022461	36.149	7.808	1456.88	1.366	0.0337861	618.546	6.864
1283.37	1.380	0.0026011	41.948	7.792	1460.28	1.360	0.0314757	577.592	6.848
1286.01	1.380	0.0029267	47.296	7.776	1463.70	1.354	0.0272672	501.537	6.832
1288.66	1.379	0.0035729	57.859	7.760	1467.14	1.351	0.0197171	363.516	6.816
1299.38	1.378	0.0035502	57.969	7.696	1470.59	1.351	0.0121199	223.976	6.800
1302.08	1.378	0.0029201	47.780	7.680	1474.06	1.355	0.0074225	137.492	6.784
1304.80	1.378	0.0022414	36.751	7.664	1477.54	1.358	0.0059129	109.786	6.768
1307.53	1.379	0.0020190	33.174	7.648	1481.04	1.360	0.0048130	89.576	6.752
1310.27	1.379	0.0021400	35.235	7.632	1484.56	1.361	0.0036990	69.007	6.736
1313.03	1.380	0.0024576	40.550	7.616	1488.10	1.363	0.0026140	48.882	6.720
1315.79	1.380	0.0029295	48.438	7.600	1491.65	1.364	0.0024515	45.952	6.704
1318.57	1.380	0.0031247	51.774	7.584	1495.22	1.365	0.0024382	45.812	6.688
1321.35	1.380	0.0029315	48.677	7.568	1498.80	1.366	0.0022972	43.266	6.672
1324.15	1.380	0.0027497	45.754	7.552	1502.40	1.367	0.0017621	33.267	6.656
1326.96	1.380	0.0025559	42.619	7.536	1524.39	1.370	0.0015924	30.503	6.560
1329.79	1.380	0.0024631	41.160	7.520	1528.12	1.370	0.0015434	29.638	6.544
1332.62	1.381	0.0025910	43.390	7.504	1535.63	1.371	0.0013339	25.741	6.512
1335.47	1.381	0.0031636	53.091	7.488	1539.41	1.371	0.0013401	25.924	6.496
1338.33	1.381	0.0037167	62.507	7.472	1543.21	1.371	0.0015104	29.291	6.480
1341.20	1.381	0.0038025	64.087	7.456	1547.03	1.371	0.0015328	29.798	6.464
1344.09	1.381	0.0036512	61.670	7.440	1550.87	1.372	0.0011834	23.063	6.448
1346.98	1.381	0.0035119	59.445	7.424	1594.39	1.375	0.0010760	21.559	6.272
1349.89	1.382	0.0032479	55.095	7.408	1598.47	1.376	0.0013712	27.543	6.256
1352.81	1.382	0.0035968	61.145	7.392	1602.56	1.376	0.0014927	30.061	6.240
1355.75	1.383	0.0036459	62.114	7.376	1606.68	1.377	0.0016254	32.817	6.224
1358.70	1.383	0.0040262	68.743	7.360	1610.83	1.378	0.0023429	47.425	6.208
1361.66	1.384	0.0047140	80.662	7.344	1614.99	1.378	0.0026436	53.651	6.192
1364.63	1.385	0.0053897	92.424	7.328	1619.17	1.380	0.0036405	74.073	6.176
1367.62	1.385	0.0073740	126.730	7.312	1623.38	1.381	0.0055164	112.534	6.160
1370.61	1.384	0.0097646	168.182	7.296	1627.60	1.381	0.0098176	200.800	6.144
1373.63	1.381	0.0103315	178.338	7.280	1631.85	1.378	0.0142047	291.289	6.128
1376.65	1.379	0.0090911	157.271	7.264	1636.13	1.372	0.0154037	316.702	6.112

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1640.42	1.367	0.0116111	239.353	6.096	1885.37	1.375	0.0003235	7.665	5.304
1644.74	1.365	0.0068918	142.443	6.080	1888.22	1.375	0.0003343	7.933	5.296
1649.08	1.366	0.0034949	72.425	6.064	1891.07	1.375	0.0003458	8.217	5.288
1653.44	1.368	0.0021616	44.912	6.048	1893.94	1.375	0.0003400	8.093	5.280
1657.83	1.369	0.0016114	33.571	6.032	1896.81	1.375	0.0003378	8.053	5.272
1662.23	1.370	0.0011231	23.459	6.016	1899.70	1.375	0.0003238	7.729	5.264
1666.67	1.371	0.0010380	21.740	6.000	1902.59	1.375	0.0002995	7.162	5.256
1671.12	1.371	0.0009693	20.355	5.984	1905.49	1.375	0.0002867	6.865	5.248
1675.60	1.371	0.0008752	18.429	5.968	1908.40	1.375	0.0002626	6.297	5.240
1680.11	1.372	0.0007714	16.287	5.952	1911.32	1.376	0.0002474	5.941	5.232
1684.64	1.372	0.0006758	14.307	5.936	1914.24	1.376	0.0002357	5.671	5.224
1689.19	1.372	0.0006364	13.508	5.920	1917.18	1.376	0.0002190	5.277	5.216
1693.77	1.372	0.0005611	11.943	5.904	1920.12	1.376	0.0002143	5.171	5.208
1698.37	1.373	0.0005365	11.449	5.888	1923.08	1.376	0.0002068	4.999	5.200
1703.00	1.373	0.0004837	10.351	5.872	1926.04	1.376	0.0001995	4.830	5.192
1707.65	1.373	0.0004644	9.965	5.856	1929.01	1.376	0.0002049	4.968	5.184
1712.33	1.373	0.0004339	9.336	5.840	1931.99	1.376	0.0002033	4.936	5.176
1717.03	1.373	0.0004003	8.637	5.824	1934.99	1.376	0.0002105	5.119	5.168
1721.76	1.374	0.0003949	8.544	5.808	1937.98	1.376	0.0002197	5.349	5.160
1726.52	1.374	0.0003611	7.835	5.792	1940.99	1.376	0.0002276	5.552	5.152
1731.30	1.374	0.0003621	7.877	5.776	1944.01	1.376	0.0002372	5.796	5.144
1736.11	1.374	0.0003429	7.480	5.760	1947.04	1.376	0.0002501	6.119	5.136
1740.95	1.374	0.0003424	7.491	5.744	1950.08	1.376	0.0002642	6.474	5.128
1745.81	1.374	0.0003338	7.322	5.728	1953.13	1.376	0.0002845	6.982	5.120
1750.70	1.374	0.0003306	7.274	5.712	1956.18	1.376	0.0003137	7.710	5.112
1755.62	1.375	0.0003387	7.472	5.696	1959.25	1.376	0.0003551	8.743	5.104
1760.56	1.375	0.0003364	7.443	5.680	1962.32	1.376	0.0004033	9.945	5.096
1765.54	1.375	0.0003419	7.585	5.664	1965.41	1.376	0.0004513	11.146	5.088
1770.54	1.375	0.0003873	8.617	5.648	1968.50	1.376	0.0004933	12.203	5.080
1775.57	1.375	0.0004052	9.041	5.632	1971.61	1.376	0.0005137	12.728	5.072
1780.63	1.375	0.0004645	10.395	5.616	1974.72	1.376	0.0005103	12.664	5.064
1785.71	1.376	0.0005838	13.100	5.600	1977.85	1.376	0.0004841	12.033	5.056
1790.83	1.376	0.0006450	14.515	5.584	1980.98	1.376	0.0004432	11.032	5.048
1795.98	1.376	0.0011777	26.579	5.568	1984.13	1.376	0.0003876	9.664	5.040
1801.15	1.376	0.0017466	39.531	5.552	1987.28	1.376	0.0003421	8.542	5.032
1806.36	1.376	0.0023508	53.361	5.536	1990.45	1.376	0.0002967	7.420	5.024
1811.59	1.375	0.0027194	61.907	5.520	1993.62	1.376	0.0002665	6.676	5.016
1816.86	1.375	0.0026575	60.675	5.504	1996.81	1.376	0.0002444	6.132	5.008
1822.16	1.374	0.0021673	49.627	5.488	2000.00	1.376	0.0002296	5.771	5.000
1827.49	1.374	0.0015150	34.792	5.472	2003.21	1.376	0.0002244	5.649	4.992
1832.85	1.374	0.0009297	21.413	5.456	2006.42	1.376	0.0002214	5.583	4.984
1838.24	1.374	0.0006780	15.662	5.440	2009.65	1.376	0.0002259	5.706	4.976
1843.66	1.374	0.0005407	12.526	5.424	2012.88	1.376	0.0002346	5.933	4.968
1849.11	1.375	0.0004280	9.945	5.408	2016.13	1.376	0.0002436	6.173	4.960
1851.85	1.375	0.0004654	10.830	5.400	2019.39	1.376	0.0002549	6.470	4.952
1854.60	1.375	0.0004263	9.934	5.392	2022.65	1.376	0.0002662	6.766	4.944
1857.36	1.375	0.0003843	8.969	5.384	2025.93	1.376	0.0002728	6.946	4.936
1860.12	1.375	0.0003638	8.503	5.376	2029.22	1.376	0.0002702	6.889	4.928
1862.89	1.375	0.0003330	7.795	5.368	2032.52	1.376	0.0002669	6.817	4.920
1865.67	1.375	0.0003237	7.589	5.360	2035.83	1.376	0.0002579	6.597	4.912
1868.46	1.375	0.0003140	7.372	5.352	2039.15	1.377	0.0002432	6.232	4.904
1871.26	1.375	0.0002998	7.049	5.344	2042.48	1.377	0.0002332	5.985	4.896
1874.06	1.375	0.0003023	7.119	5.336	2045.83	1.377	0.0002246	5.775	4.888
1876.88	1.375	0.0003002	7.081	5.328	2049.18	1.377	0.0002204	5.676	4.880
1879.70	1.375	0.0003039	7.180	5.320	2052.55	1.377	0.0002214	5.710	4.872
1882.53	1.375	0.0003152	7.457	5.312	2055.92	1.377	0.0002250	5.813	4.864

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2059.31	1.377	0.0002279	5.897	4.856	2268.60	1.378	0.0002541	7.243	4.408
2062.71	1.377	0.0002367	6.137	4.848	2272.73	1.378	0.0002511	7.170	4.400
2066.12	1.377	0.0002371	6.155	4.840	2276.87	1.378	0.0002437	6.971	4.392
2069.54	1.377	0.0002356	6.126	4.832	2281.02	1.378	0.0002387	6.841	4.384
2072.97	1.377	0.0002342	6.100	4.824	2285.19	1.378	0.0002327	6.684	4.376
2076.41	1.377	0.0002247	5.863	4.816	2289.38	1.378	0.0002330	6.704	4.368
2079.87	1.377	0.0002168	5.667	4.808	2293.58	1.378	0.0002344	6.756	4.360
2083.33	1.377	0.0002075	5.433	4.800	2297.79	1.378	0.0002326	6.716	4.352
2086.81	1.377	0.0001946	5.104	4.792	2302.03	1.378	0.0002299	6.652	4.344
2090.30	1.377	0.0001871	4.915	4.784	2306.27	1.378	0.0002404	6.966	4.336
2093.80	1.377	0.0001816	4.779	4.776	2310.54	1.378	0.0002390	6.939	4.328
2097.32	1.377	0.0001709	4.505	4.768	2314.82	1.378	0.0002445	7.112	4.320
2100.84	1.377	0.0001674	4.419	4.760	2319.11	1.378	0.0002487	7.248	4.312
2104.38	1.377	0.0001632	4.315	4.752	2323.42	1.378	0.0002448	7.148	4.304
2107.93	1.377	0.0001571	4.162	4.744	2327.75	1.378	0.0002425	7.095	4.296
2111.49	1.377	0.0001577	4.183	4.736	2332.09	1.378	0.0002384	6.987	4.288
2115.06	1.377	0.0001554	4.131	4.728	2336.45	1.378	0.0002292	6.729	4.280
2118.64	1.377	0.0001537	4.093	4.720	2340.82	1.378	0.0002222	6.536	4.272
2122.24	1.377	0.0001584	4.225	4.712	2345.22	1.378	0.0002225	6.559	4.264
2125.85	1.377	0.0001578	4.215	4.704	2349.62	1.378	0.0002320	6.849	4.256
2129.47	1.377	0.0001598	4.275	4.696	2354.05	1.379	0.0002381	7.043	4.248
2133.11	1.377	0.0001654	4.433	4.688	2358.49	1.379	0.0002598	7.699	4.240
2136.75	1.377	0.0001676	4.501	4.680	2362.95	1.379	0.0002643	7.847	4.232
2140.41	1.377	0.0001746	4.696	4.672	2367.42	1.379	0.0002778	8.264	4.224
2144.08	1.377	0.0001803	4.859	4.664	2371.92	1.379	0.0002697	8.039	4.216
2147.77	1.377	0.0001892	5.105	4.656	2376.43	1.379	0.0002702	8.070	4.208
2151.46	1.377	0.0001962	5.305	4.648	2380.95	1.379	0.0002660	7.959	4.200
2155.17	1.377	0.0001999	5.413	4.640	2385.50	1.379	0.0002547	7.634	4.192
2158.90	1.377	0.0002052	5.567	4.632	2390.06	1.379	0.0002450	7.359	4.184
2162.63	1.377	0.0002101	5.708	4.624	2394.64	1.379	0.0002379	7.160	4.176
2166.38	1.377	0.0002122	5.776	4.616	2399.23	1.379	0.0002345	7.070	4.168
2170.14	1.377	0.0002146	5.854	4.608	2403.85	1.379	0.0002324	7.021	4.160
2173.91	1.377	0.0002166	5.917	4.600	2408.48	1.379	0.0002304	6.974	4.152
2177.70	1.377	0.0002213	6.056	4.592	2413.13	1.379	0.0002336	7.082	4.144
2181.50	1.377	0.0002231	6.116	4.584	2417.80	1.379	0.0002324	7.061	4.136
2185.32	1.378	0.0002304	6.328	4.576	2422.48	1.379	0.0002370	7.214	4.128
2189.14	1.378	0.0002392	6.582	4.568	2427.18	1.379	0.0002360	7.199	4.120
2192.98	1.378	0.0002482	6.839	4.560	2431.91	1.379	0.0002335	7.136	4.112
2196.84	1.378	0.0002598	7.171	4.552	2436.65	1.379	0.0002316	7.090	4.104
2200.70	1.378	0.0002683	7.421	4.544	2441.41	1.379	0.0002260	6.934	4.096
2204.59	1.378	0.0002786	7.718	4.536	2446.18	1.379	0.0002212	6.801	4.088
2208.48	1.378	0.0002799	7.769	4.528	2450.98	1.379	0.0002140	6.593	4.080
2212.39	1.378	0.0002818	7.835	4.520	2455.80	1.379	0.0002056	6.345	4.072
2216.31	1.378	0.0002807	7.817	4.512	2460.63	1.379	0.0002015	6.232	4.064
2220.25	1.378	0.0002732	7.621	4.504	2465.48	1.379	0.0001954	6.054	4.056
2224.20	1.378	0.0002678	7.484	4.496	2470.36	1.379	0.0001930	5.991	4.048
2228.16	1.378	0.0002663	7.457	4.488	2475.25	1.379	0.0001936	6.022	4.040
2232.14	1.378	0.0002618	7.344	4.480	2480.16	1.380	0.0001944	6.059	4.032
2236.14	1.378	0.0002630	7.391	4.472	2485.09	1.380	0.0002008	6.272	4.024
2240.14	1.378	0.0002677	7.535	4.464	2490.04	1.380	0.0002066	6.466	4.016
2244.17	1.378	0.0002665	7.515	4.456	2495.01	1.380	0.0002184	6.847	4.008
2248.20	1.378	0.0002691	7.603	4.448	2500.00	1.380	0.0002323	7.297	4.000
2252.25	1.378	0.0002662	7.535	4.440	2505.01	1.380	0.0002452	7.719	3.992
2256.32	1.378	0.0002642	7.491	4.432	2510.04	1.380	0.0002631	8.299	3.984
2260.40	1.378	0.0002650	7.528	4.424	2515.09	1.380	0.0002801	8.852	3.976
2264.49	1.378	0.0002584	7.354	4.416	2520.16	1.380	0.0002990	9.471	3.968

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2525.25	1.380	0.0003154	10.008	3.960	2860.41	1.393	0.0219709	789.743	3.496
2530.36	1.380	0.0003308	10.520	3.952	2866.97	1.391	0.0221709	798.762	3.488
2535.50	1.380	0.0003670	11.693	3.944	2873.56	1.390	0.0220838	797.452	3.480
2540.65	1.380	0.0003687	11.772	3.936	2880.18	1.390	0.0225599	816.518	3.472
2545.83	1.380	0.0003779	12.088	3.928	2886.84	1.391	0.0239228	867.851	3.464
2551.02	1.380	0.0003925	12.583	3.920	2893.52	1.390	0.0260091	945.717	3.456
2556.24	1.381	0.0004119	13.231	3.912	2900.23	1.390	0.0285465	1040.386	3.448
2561.48	1.381	0.0004279	13.773	3.904	2906.98	1.389	0.0321418	1174.146	3.440
2566.74	1.381	0.0004460	14.387	3.896	2913.75	1.385	0.0359471	1316.214	3.432
2572.02	1.381	0.0004654	15.041	3.888	2920.56	1.381	0.0378924	1390.684	3.424
2577.32	1.381	0.0004777	15.472	3.880	2927.40	1.375	0.0403468	1484.229	3.416
2582.65	1.381	0.0004899	15.898	3.872	2934.27	1.368	0.0397191	1464.569	3.408
2587.99	1.381	0.0004992	16.236	3.864	2941.18	1.362	0.0363728	1344.336	3.400
2593.36	1.381	0.0005036	16.412	3.856	2948.11	1.357	0.0320329	1186.726	3.392
2598.75	1.381	0.0005109	16.683	3.848	2955.08	1.354	0.0262065	973.167	3.384
2604.17	1.381	0.0005194	16.996	3.840	2962.09	1.352	0.0214361	797.909	3.376
2609.60	1.381	0.0005299	17.378	3.832	2969.12	1.352	0.0161466	602.447	3.368
2615.06	1.381	0.0005481	18.010	3.824	2976.19	1.353	0.0119042	445.215	3.360
2620.55	1.381	0.0005709	18.801	3.816	2983.29	1.354	0.0083628	313.515	3.352
2637.13	1.382	0.0005800	19.221	3.792	2990.43	1.356	0.0056239	211.340	3.344
2642.71	1.382	0.0006286	20.877	3.784	2997.60	1.358	0.0041457	156.163	3.336
2648.31	1.382	0.0006609	21.994	3.776	3004.81	1.360	0.0030061	113.509	3.328
2653.93	1.382	0.0006923	23.088	3.768	3012.05	1.362	0.0023249	88.000	3.320
2659.57	1.382	0.0007322	24.472	3.760	3019.32	1.364	0.0019677	74.659	3.312
2665.25	1.382	0.0007515	25.171	3.752	3026.63	1.365	0.0020283	77.142	3.304
2670.94	1.382	0.0007396	24.825	3.744	3033.98	1.367	0.0024179	92.185	3.296
2676.66	1.383	0.0007104	23.895	3.736	3041.36	1.368	0.0030591	116.915	3.288
2682.40	1.383	0.0006848	23.084	3.728	3048.78	1.368	0.0038084	145.909	3.280
2688.17	1.383	0.0006789	22.932	3.720	3056.24	1.368	0.0043704	167.850	3.272
2693.97	1.383	0.0006789	22.984	3.712	3063.73	1.367	0.0045244	174.190	3.264
2699.78	1.383	0.0006987	23.704	3.704	3071.25	1.367	0.0041539	160.318	3.256
2705.63	1.384	0.0007280	24.753	3.696	3078.82	1.367	0.0034988	135.367	3.248
2711.50	1.384	0.0008023	27.337	3.688	3086.42	1.367	0.0027932	108.336	3.240
2717.39	1.384	0.0008681	29.645	3.680	3094.06	1.367	0.0021874	85.049	3.232
2723.31	1.384	0.0009177	31.404	3.672	3101.74	1.367	0.0016370	63.805	3.224
2729.26	1.385	0.0009613	32.971	3.664	3109.45	1.368	0.0009536	37.261	3.216
2735.23	1.385	0.0009913	34.073	3.656	3117.21	1.368	0.0007830	30.670	3.208
2741.23	1.385	0.0010084	34.738	3.648	3125.00	1.369	0.0006559	25.756	3.200
2747.25	1.386	0.0010220	35.282	3.640	3132.83	1.369	0.0006291	24.768	3.192
2753.30	1.386	0.0010478	36.254	3.632	3140.70	1.370	0.0005832	23.018	3.184
2759.38	1.387	0.0011141	38.630	3.624	3148.62	1.370	0.0005575	22.057	3.176
2765.49	1.387	0.0012051	41.879	3.616	3156.57	1.370	0.0005272	20.911	3.168
2771.62	1.388	0.0013315	46.374	3.608	3164.56	1.370	0.0004943	19.657	3.160
2777.78	1.388	0.0016067	56.085	3.600	3172.59	1.371	0.0004700	18.738	3.152
2783.96	1.389	0.0017098	59.815	3.592	3180.66	1.371	0.0004328	17.299	3.144
2790.18	1.390	0.0020372	71.428	3.584	3188.78	1.371	0.0003958	15.859	3.136
2796.42	1.391	0.0023175	81.438	3.576	3196.93	1.371	0.0003609	14.501	3.128
2802.69	1.392	0.0027143	95.598	3.568	3205.13	1.371	0.0003194	12.866	3.120
2808.99	1.393	0.0029658	104.689	3.560	3213.37	1.371	0.0002835	11.447	3.112
2815.32	1.395	0.0042470	150.253	3.552	3221.65	1.372	0.0002567	10.391	3.104
2821.67	1.397	0.0058306	206.741	3.544	3229.97	1.372	0.0002310	9.378	3.096
2828.05	1.399	0.0088004	312.753	3.536	3238.34	1.372	0.0002080	8.466	3.088
2834.47	1.400	0.0118626	422.536	3.528	3246.75	1.372	0.0001936	7.899	3.080
2840.91	1.400	0.0155649	555.667	3.520	3255.21	1.372	0.0001792	7.331	3.072
2847.38	1.398	0.0195235	698.575	3.512	3263.71	1.372	0.0001628	6.679	3.064
2853.88	1.395	0.0206651	741.111	3.504	3272.25	1.373	0.0001522	6.260	3.056

1-HEXENE					1-HEXENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3280.84	1.373	0.0001418	5.844	3.048	3846.15	1.376	0.0001376	6.650	2.600
3289.47	1.373	0.0001355	5.602	3.040	3858.03	1.376	0.0001384	6.710	2.592
3298.15	1.373	0.0001301	5.391	3.032	3869.97	1.376	0.0001318	6.410	2.584
3306.88	1.373	0.0001244	5.171	3.024	3881.99	1.376	0.0001256	6.129	2.576
3315.65	1.373	0.0001235	5.148	3.016	3894.08	1.376	0.0001354	6.628	2.568
3324.47	1.373	0.0001197	5.003	3.008	3906.25	1.376	0.0001372	6.733	2.560
3333.33	1.373	0.0001180	4.943	3.000	4000.00	1.376	0.0003277	16.470	2.500
3342.25	1.373	0.0001171	4.918	2.992	4185.85	1.376	0.0005058	26.606	2.389
3351.21	1.373	0.0001156	4.866	2.984	4337.34	1.376	0.0006164	33.594	2.306
3360.22	1.374	0.0001115	4.708	2.976	4390.20	1.376	0.0002101	11.590	2.278
3369.27	1.374	0.0001084	4.588	2.968	4444.44	1.376	0.0002522	14.087	2.250
3378.38	1.374	0.0001054	4.474	2.960	4500.05	1.376	0.0000790	4.465	2.222
3387.53	1.374	0.0001024	4.357	2.952	4615.31	1.377	0.0000612	3.551	2.167
3396.74	1.374	0.0000989	4.220	2.944	4675.30	1.377	0.0001246	7.318	2.139
3406.00	1.374	0.0000972	4.158	2.936	4800.08	1.377	0.0000426	2.572	2.083
3415.30	1.374	0.0000933	4.004	2.928	5000.00	1.377	0.0000447	2.810	2.000
3424.66	1.374	0.0000899	3.869	2.920					
3434.07	1.374	0.0000845	3.646	2.912					
3443.53	1.374	0.0000789	3.416	2.904					
3453.04	1.374	0.0000746	3.237	2.896					
3462.60	1.374	0.0000708	3.079	2.888					
3472.22	1.374	0.0000674	2.939	2.880					
3481.89	1.374	0.0000645	2.823	2.872					
3491.62	1.374	0.0000640	2.809	2.864					
3501.40	1.374	0.0000644	2.834	2.856					
3511.24	1.375	0.0000663	2.926	2.848					
3521.13	1.375	0.0000663	2.932	2.840					
3531.07	1.375	0.0000673	2.988	2.832					
3541.08	1.375	0.0000683	3.040	2.824					
3551.14	1.375	0.0000689	3.073	2.816					
3561.25	1.375	0.0000696	3.115	2.808					
3571.43	1.375	0.0000736	3.304	2.800					
3581.66	1.375	0.0000783	3.526	2.792					
3591.95	1.375	0.0000844	3.811	2.784					
3602.31	1.375	0.0000945	4.280	2.776					
3612.72	1.375	0.0001018	4.620	2.768					
3623.19	1.375	0.0001087	4.948	2.760					
3633.72	1.375	0.0001142	5.213	2.752					
3644.32	1.375	0.0001177	5.389	2.744					
3654.97	1.375	0.0001186	5.448	2.736					
3665.69	1.375	0.0001196	5.507	2.728					
3676.47	1.375	0.0001207	5.577	2.720					
3687.32	1.375	0.0001196	5.540	2.712					
3698.23	1.375	0.0001203	5.591	2.704					
3709.20	1.375	0.0001210	5.639	2.696					
3720.24	1.375	0.0001219	5.697	2.688					
3731.34	1.375	0.0001234	5.788	2.680					
3742.52	1.375	0.0001269	5.969	2.672					
3753.75	1.375	0.0001295	6.110	2.664					
3765.06	1.376	0.0001334	6.314	2.656					
3776.44	1.376	0.0001367	6.488	2.648					
3787.88	1.376	0.0001392	6.627	2.640					
3799.39	1.376	0.0001416	6.759	2.632					
3810.98	1.376	0.0001408	6.743	2.624					
3822.63	1.376	0.0001433	6.884	2.616					
3834.36	1.376	0.0001397	6.730	2.608					

o-XYLENE					o-XYLENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
666.67	1.526	0.0011512	9.644	15.000	758.50	1.367	0.0147654	140.738	13.184
678.18	1.532	0.0015315	13.051	14.745	759.42	1.374	0.0120100	114.614	13.168
683.23	1.536	0.0017306	14.859	14.636	760.34	1.381	0.0098811	94.411	13.152
689.66	1.539	0.0025232	18.697	14.500	761.27	1.388	0.0091717	87.741	13.136
695.36	1.543	0.0027446	23.982	14.381	762.20	1.393	0.0085813	82.192	13.120
711.46	1.575	0.0048116	43.018	14.056	763.13	1.398	0.0064443	61.799	13.104
714.29	1.589	0.0121901	109.419	14.000	764.06	1.404	0.0063262	60.741	13.088
715.92	1.590	0.0132163	118.901	13.968	764.99	1.408	0.0065086	62.568	13.072
716.74	1.593	0.0134622	121.252	13.952	765.93	1.412	0.0061039	58.749	13.056
717.57	1.597	0.0158283	142.728	13.936	768.76	1.421	0.0062049	59.943	13.008
719.22	1.602	0.0172081	155.527	13.904	769.70	1.423	0.0058164	56.258	12.992
720.05	1.606	0.0186079	168.372	13.888	771.60	1.428	0.0056513	54.796	12.960
721.71	1.614	0.0215081	195.063	13.856	772.56	1.430	0.0057079	55.414	12.944
723.38	1.626	0.0228473	207.688	13.824	774.47	1.434	0.0057307	55.773	12.912
724.22	1.637	0.0262086	238.520	13.808	775.43	1.435	0.0050376	49.088	12.896
725.06	1.643	0.0396668	361.419	13.792	776.40	1.437	0.0048642	47.458	12.880
725.90	1.644	0.0408403	372.542	13.776	778.33	1.440	0.0047416	46.377	12.848
726.74	1.651	0.0432902	395.347	13.760	779.30	1.441	0.0041101	40.250	12.832
727.59	1.657	0.0514588	470.497	13.744	780.27	1.443	0.0044370	43.506	12.816
728.44	1.665	0.0509611	466.490	13.728	781.25	1.444	0.0037155	36.476	12.800
729.29	1.675	0.0628264	575.774	13.712	782.23	1.445	0.0036147	35.531	12.784
730.14	1.685	0.0653981	600.041	13.696	783.21	1.446	0.0033169	32.646	12.768
730.99	1.697	0.0796640	731.785	13.680	784.19	1.448	0.0027874	27.468	12.752
731.85	1.707	0.0890372	818.848	13.664	786.16	1.450	0.0027275	26.946	12.720
732.71	1.724	0.0988851	910.486	13.648	787.15	1.452	0.0027960	27.657	12.704
733.57	1.743	0.1242469	1145.347	13.632	789.14	1.454	0.0027736	27.505	12.672
734.43	1.752	0.1499097	1383.535	13.616	791.14	1.455	0.0027375	27.216	12.640
735.29	1.770	0.1671493	1544.447	13.600	792.14	1.456	0.0027185	27.060	12.624
736.16	1.796	0.2129610	1970.072	13.584	793.15	1.457	0.0026132	26.046	12.608
737.03	1.784	0.2828308	2619.520	13.568	794.16	1.457	0.0024242	24.193	12.592
737.90	1.788	0.2814888	2610.168	13.552	795.17	1.458	0.0020782	20.767	12.576
738.77	1.817	0.3804763	3532.212	13.536	796.18	1.459	0.0020149	20.160	12.560
739.65	1.765	0.4954611	4605.170	13.520	802.31	1.463	0.0019545	19.705	12.464
740.52	1.690	0.5445368	5067.268	13.504	803.34	1.464	0.0019590	19.776	12.448
741.40	1.540	0.6590555	6140.227	13.488	805.41	1.465	0.0018870	19.098	12.416
742.28	1.375	0.5432456	5067.268	13.472	806.45	1.466	0.0016411	16.631	12.400
743.16	1.295	0.4931210	4605.170	13.456	807.49	1.466	0.0016226	16.465	12.384
744.05	1.243	0.3777764	3532.212	13.440	808.54	1.467	0.0015242	15.486	12.368
744.93	1.225	0.3279662	3070.113	13.424	810.64	1.468	0.0014351	14.619	12.336
745.82	1.229	0.2335647	2189.027	13.408	812.74	1.469	0.0014314	14.619	12.304
746.71	1.245	0.2271398	2131.351	13.392	813.80	1.470	0.0017667	18.068	12.288
747.61	1.243	0.1724499	1620.123	13.376	814.86	1.470	0.0018034	18.467	12.272
748.50	1.255	0.1555101	1462.717	13.360	815.93	1.471	0.0018126	18.585	12.256
749.40	1.265	0.1206954	1136.617	13.344	816.99	1.471	0.0020202	20.741	12.240
750.30	1.277	0.1117646	1053.778	13.328	818.06	1.472	0.0020534	21.109	12.224
751.20	1.286	0.0891181	841.262	13.312	820.21	1.472	0.0020734	21.371	12.192
752.11	1.287	0.0874798	826.797	13.296	821.29	1.473	0.0022624	23.350	12.176
753.01	1.291	0.0506985	479.740	13.280	822.37	1.473	0.0024741	25.568	12.160
753.92	1.313	0.0395530	374.726	13.264	823.45	1.474	0.0026347	27.263	12.144
754.83	1.324	0.0363676	344.964	13.248	824.54	1.474	0.0028513	29.543	12.128
755.74	1.334	0.0214021	203.254	13.232	825.63	1.474	0.0031946	33.145	12.112
756.66	1.349	0.0190208	180.858	13.216	826.72	1.474	0.0030983	32.188	12.096
757.58	1.359	0.0164060	156.185	13.200	827.81	1.474	0.0028203	29.339	12.080
					828.91	1.474	0.0026145	27.234	12.064
					830.01	1.474	0.0023287	24.288	12.048
					831.12	1.475	0.0021817	22.786	12.032

o-XYLENE					o-XYLENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
832.22	1.475	0.0019598	20.495	12.016	937.03	1.490	0.0033066	38.936	10.672
833.33	1.475	0.0017131	17.940	12.000	938.44	1.490	0.0031960	37.690	10.656
837.80	1.477	0.0017164	18.070	11.936	939.85	1.490	0.0030335	35.828	10.640
838.93	1.477	0.0019172	20.211	11.920	941.27	1.491	0.0028611	33.842	10.624
840.05	1.478	0.0018930	19.983	11.904	942.68	1.491	0.0028284	33.505	10.608
843.45	1.479	0.0019661	20.839	11.856	944.11	1.491	0.0026190	31.072	10.592
844.59	1.479	0.0019430	20.622	11.840	945.54	1.491	0.0024224	28.783	10.576
845.74	1.479	0.0020174	21.441	11.824	946.97	1.492	0.0023188	27.594	10.560
848.03	1.480	0.0020944	22.320	11.792	948.41	1.492	0.0021396	25.500	10.544
849.18	1.480	0.0022572	24.087	11.776	949.85	1.493	0.0020960	25.018	10.528
850.34	1.481	0.0024850	26.554	11.760	951.29	1.493	0.0022063	26.374	10.512
851.50	1.481	0.0028765	30.780	11.744	952.74	1.494	0.0022320	26.723	10.496
852.66	1.481	0.0031020	33.237	11.728	954.20	1.494	0.0024231	29.055	10.480
853.83	1.481	0.0034290	36.792	11.712	955.66	1.494	0.0025957	31.172	10.464
856.16	1.481	0.0037329	40.161	11.680	957.12	1.495	0.0026343	31.684	10.448
857.34	1.481	0.0036531	39.357	11.664	958.59	1.495	0.0028008	33.738	10.432
859.70	1.480	0.0034628	37.409	11.632	960.06	1.496	0.0028136	33.945	10.416
860.88	1.481	0.0031111	33.656	11.616	961.54	1.496	0.0030555	36.919	10.400
862.07	1.481	0.0031334	33.944	11.600	963.02	1.497	0.0032229	39.002	10.384
863.26	1.481	0.0028732	31.169	11.584	964.51	1.498	0.0039993	48.473	10.368
864.45	1.481	0.0027273	29.627	11.568	966.00	1.498	0.0042105	51.111	10.352
865.65	1.481	0.0027390	29.795	11.552	967.49	1.498	0.0043711	53.143	10.336
866.85	1.481	0.0024504	26.693	11.536	968.99	1.500	0.0042846	52.172	10.320
868.06	1.481	0.0024422	26.640	11.520	970.50	1.501	0.0068871	83.993	10.304
869.26	1.481	0.0022596	24.683	11.504	972.01	1.501	0.0073065	89.246	10.288
870.47	1.482	0.0019843	21.706	11.488	973.52	1.501	0.0088722	108.539	10.272
871.69	1.482	0.0019226	21.060	11.472	975.04	1.501	0.0092884	113.808	10.256
875.35	1.483	0.0018331	20.164	11.424	976.56	1.502	0.0108150	132.720	10.240
876.58	1.483	0.0018437	20.309	11.408	978.09	1.501	0.0134453	165.256	10.224
884.02	1.484	0.0017926	19.914	11.312	979.62	1.500	0.0144826	178.285	10.208
887.78	1.485	0.0016106	17.968	11.264	981.16	1.499	0.0170114	209.744	10.192
891.58	1.485	0.0016340	18.308	11.216	982.70	1.496	0.0180374	222.743	10.176
892.86	1.485	0.0015904	17.845	11.200	984.25	1.493	0.0164214	203.107	10.160
894.13	1.486	0.0015520	17.438	11.184	985.80	1.492	0.0146931	182.017	10.144
895.42	1.486	0.0014859	16.719	11.168	987.36	1.491	0.0134116	166.405	10.128
901.88	1.487	0.0013923	15.780	11.088	988.92	1.491	0.0110910	137.829	10.112
903.18	1.487	0.0014127	16.034	11.072	990.49	1.492	0.0114953	143.080	10.096
909.75	1.488	0.0014064	16.079	10.992	992.06	1.492	0.0102514	127.800	10.080
912.41	1.489	0.0014292	16.387	10.960	993.64	1.493	0.0099837	124.661	10.064
913.74	1.489	0.0015654	17.975	10.944	995.22	1.494	0.0099978	125.035	10.048
915.08	1.490	0.0016904	19.438	10.928	996.81	1.494	0.0098457	123.330	10.032
916.42	1.490	0.0018679	21.511	10.912	998.40	1.495	0.0101432	127.259	10.016
917.77	1.490	0.0020711	23.886	10.896	1000.00	1.496	0.0100209	125.927	10.000
919.12	1.490	0.0021405	24.723	10.880	1001.60	1.497	0.0105297	132.532	9.984
920.47	1.490	0.0023071	26.686	10.864	1003.21	1.498	0.0115146	145.162	9.968
921.83	1.491	0.0025478	29.514	10.848	1004.82	1.499	0.0119071	150.351	9.952
923.19	1.491	0.0027155	31.503	10.832	1006.44	1.499	0.0144112	182.263	9.936
924.56	1.491	0.0030584	35.533	10.816	1008.07	1.499	0.0142318	180.285	9.920
925.93	1.491	0.0036607	42.594	10.800	1009.69	1.500	0.0164928	209.263	9.904
927.30	1.491	0.0040389	47.064	10.784	1011.33	1.501	0.0185681	235.977	9.888
928.68	1.491	0.0043110	50.310	10.768	1012.97	1.501	0.0209733	266.977	9.872
930.06	1.491	0.0047644	55.684	10.752	1014.61	1.500	0.0247606	315.696	9.856
931.45	1.490	0.0045146	52.843	10.736	1016.26	1.497	0.0287282	366.879	9.840
932.84	1.490	0.0042383	49.683	10.720	1017.92	1.493	0.0306807	392.453	9.824
934.23	1.490	0.0040490	47.535	10.704	1019.58	1.486	0.0333261	426.988	9.808
935.63	1.490	0.0036067	42.405	10.688	1021.24	1.480	0.0282289	362.270	9.792

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frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1022.91	1.477	0.0231123	297.092	9.776	1136.36	1.485	0.0038044	54.327	8.800
1024.59	1.477	0.0187196	241.023	9.760	1138.43	1.485	0.0040471	57.898	8.784
1026.27	1.479	0.0157547	203.180	9.744	1140.51	1.485	0.0038663	55.412	8.768
1027.96	1.480	0.0148143	191.367	9.728	1142.60	1.485	0.0033450	48.029	8.752
1029.65	1.481	0.0132526	171.475	9.712	1144.69	1.485	0.0025821	37.142	8.736
1031.35	1.482	0.0120038	155.573	9.696	1146.79	1.486	0.0019553	28.178	8.720
1033.06	1.483	0.0117602	152.669	9.680	1153.14	1.487	0.0016547	23.978	8.672
1034.77	1.484	0.0115256	149.871	9.664	1155.27	1.488	0.0020355	29.550	8.656
1036.48	1.485	0.0107778	140.378	9.648	1157.41	1.488	0.0022544	32.790	8.640
1038.21	1.486	0.0113201	147.688	9.632	1159.56	1.488	0.0026858	39.136	8.624
1039.93	1.487	0.0116926	152.801	9.616	1161.71	1.489	0.0029678	43.325	8.608
1041.67	1.489	0.0120602	157.869	9.600	1163.87	1.489	0.0034842	50.959	8.592
1043.41	1.491	0.0142196	186.446	9.584	1166.05	1.488	0.0034586	50.679	8.576
1045.15	1.492	0.0174465	229.138	9.568	1168.22	1.488	0.0036191	53.130	8.560
1046.90	1.492	0.0225644	296.852	9.552	1170.41	1.488	0.0037166	54.663	8.544
1048.66	1.486	0.0302708	398.904	9.536	1172.61	1.488	0.0038533	56.780	8.528
1050.42	1.476	0.0292254	385.774	9.520	1174.81	1.488	0.0035077	51.784	8.512
1052.19	1.470	0.0230885	305.282	9.504	1177.02	1.488	0.0034919	51.648	8.496
1053.96	1.468	0.0172889	228.982	9.488	1179.25	1.488	0.0034215	50.703	8.480
1055.74	1.469	0.0122573	162.616	9.472	1181.47	1.488	0.0030904	45.882	8.464
1057.53	1.469	0.0102844	136.672	9.456	1183.71	1.488	0.0029645	44.096	8.448
1059.32	1.470	0.0044368	59.062	9.440	1185.96	1.487	0.0027153	40.467	8.432
1061.12	1.473	0.0035229	46.977	9.424	1188.21	1.487	0.0021948	32.772	8.416
1062.93	1.475	0.0026412	35.278	9.408	1190.48	1.488	0.0017631	26.376	8.400
1064.74	1.477	0.0020235	27.074	9.392	1195.03	1.489	0.0017478	26.248	8.368
1066.55	1.478	0.0020063	26.890	9.376	1197.32	1.489	0.0016888	25.410	8.352
1068.38	1.479	0.0018508	24.848	9.360	1201.92	1.489	0.0015260	23.049	8.320
1070.21	1.480	0.0017207	23.141	9.344	1206.56	1.490	0.0016834	25.523	8.288
1072.04	1.481	0.0016408	22.104	9.328	1208.90	1.490	0.0018716	28.433	8.272
1073.88	1.481	0.0013423	18.114	9.312	1211.24	1.491	0.0022095	33.630	8.256
1075.73	1.482	0.0010941	14.790	9.296	1213.59	1.491	0.0024298	37.055	8.240
1077.59	1.483	0.0010499	14.217	9.280	1215.95	1.491	0.0036513	55.792	8.224
1086.96	1.485	0.0010818	14.776	9.200	1218.32	1.491	0.0047394	72.560	8.208
1090.75	1.487	0.0010632	14.574	9.168	1220.70	1.489	0.0048490	74.383	8.192
1092.66	1.487	0.0012085	16.594	9.152	1223.09	1.488	0.0042004	64.559	8.176
1094.57	1.488	0.0016026	22.044	9.136	1225.49	1.488	0.0031790	48.957	8.160
1096.49	1.488	0.0016674	22.976	9.120	1227.90	1.488	0.0018184	28.058	8.144
1098.42	1.489	0.0017421	24.046	9.104	1230.32	1.489	0.0014592	22.560	8.128
1100.35	1.489	0.0018650	25.788	9.088	1232.74	1.489	0.0014211	22.015	8.112
1102.29	1.490	0.0019359	26.816	9.072	1235.18	1.489	0.0012461	19.341	8.096
1104.24	1.491	0.0026195	36.349	9.056	1237.62	1.490	0.0010935	17.006	8.080
1106.20	1.492	0.0032746	45.519	9.040	1240.08	1.490	0.0009567	14.908	8.064
1108.16	1.493	0.0032310	44.994	9.024	1245.02	1.491	0.0009324	14.588	8.032
1110.12	1.495	0.0054250	75.679	9.008	1250.00	1.491	0.0009532	14.972	8.000
1112.10	1.496	0.0080837	112.970	8.992	1257.55	1.492	0.0009493	15.002	7.952
1114.08	1.495	0.0135988	190.382	8.976	1260.08	1.492	0.0011759	18.621	7.936
1116.07	1.490	0.0178725	250.661	8.960	1262.63	1.492	0.0012255	19.445	7.920
1118.07	1.483	0.0151913	213.439	8.944	1265.18	1.492	0.0012217	19.423	7.904
1120.07	1.481	0.0107535	151.358	8.928	1267.75	1.493	0.0013250	21.109	7.888
1122.08	1.481	0.0089101	125.637	8.912	1270.33	1.493	0.0015199	24.264	7.872
1124.10	1.482	0.0062955	88.929	8.896	1272.91	1.493	0.0016655	26.641	7.856
1126.13	1.483	0.0054083	76.534	8.880	1275.51	1.493	0.0018239	29.235	7.840
1128.16	1.483	0.0047275	67.021	8.864	1278.12	1.493	0.0018329	29.439	7.824
1130.20	1.484	0.0040295	57.229	8.848	1280.74	1.493	0.0020547	33.069	7.808
1132.25	1.484	0.0036337	51.702	8.832	1283.37	1.493	0.0023257	37.508	7.792
1134.30	1.485	0.0036981	52.713	8.816	1291.32	1.493	0.0021211	34.420	7.744

o-XYLENE					o-XYLENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1294.00	1.493	0.0019054	30.984	7.728	1470.59	1.469	0.0264812	489.373	6.800
1296.68	1.493	0.0017877	29.130	7.712	1474.06	1.472	0.0217304	402.524	6.784
1299.38	1.494	0.0016614	27.128	7.696	1477.54	1.477	0.0191514	355.589	6.768
1302.08	1.494	0.0015740	25.755	7.680	1481.04	1.481	0.0221291	411.852	6.752
1304.80	1.494	0.0015058	24.690	7.664	1484.56	1.483	0.0265325	494.978	6.736
1307.53	1.494	0.0014913	24.504	7.648	1488.10	1.478	0.0349129	652.872	6.720
1310.27	1.495	0.0016681	27.466	7.632	1491.65	1.466	0.0349073	654.324	6.704
1315.79	1.495	0.0016363	27.056	7.600	1495.22	1.458	0.0260113	488.739	6.688
1318.57	1.495	0.0016562	27.442	7.584	1498.80	1.457	0.0162169	305.438	6.672
1321.35	1.496	0.0017204	28.567	7.568	1502.40	1.460	0.0082993	156.689	6.656
1324.15	1.496	0.0018220	30.317	7.552	1506.02	1.466	0.0046586	88.165	6.640
1326.96	1.496	0.0019834	33.073	7.536	1516.99	1.473	0.0043696	83.299	6.592
1329.79	1.496	0.0019510	32.602	7.520	1520.68	1.474	0.0042489	81.194	6.576
1332.62	1.497	0.0020047	33.570	7.504	1524.39	1.475	0.0040840	78.234	6.560
1338.33	1.497	0.0021060	35.418	7.472	1528.12	1.476	0.0035172	67.541	6.544
1341.20	1.498	0.0021380	36.034	7.456	1531.86	1.477	0.0033095	63.707	6.528
1344.09	1.498	0.0025519	43.102	7.440	1543.21	1.480	0.0035907	69.632	6.480
1346.98	1.499	0.0026604	45.031	7.424	1547.03	1.480	0.0038869	75.564	6.464
1349.89	1.499	0.0025764	43.704	7.408	1550.87	1.480	0.0042437	82.704	6.448
1352.81	1.500	0.0025789	43.841	7.392	1554.73	1.480	0.0039682	77.528	6.432
1355.75	1.501	0.0027872	47.485	7.376	1558.60	1.481	0.0038929	76.246	6.416
1358.70	1.502	0.0032402	55.323	7.360	1562.50	1.481	0.0038327	75.256	6.400
1361.66	1.503	0.0047452	81.195	7.344	1566.42	1.481	0.0038084	74.965	6.384
1364.63	1.504	0.0063531	108.945	7.328	1570.35	1.482	0.0041956	82.795	6.368
1367.62	1.504	0.0084220	144.740	7.312	1574.31	1.482	0.0041647	82.391	6.352
1370.61	1.504	0.0099034	170.571	7.296	1578.28	1.482	0.0040033	79.398	6.336
1373.63	1.503	0.0123290	212.818	7.280	1582.28	1.482	0.0043210	85.916	6.320
1376.65	1.500	0.0146296	253.085	7.264	1586.29	1.483	0.0044988	89.678	6.304
1379.69	1.496	0.0134878	233.847	7.248	1590.33	1.483	0.0057345	114.603	6.288
1382.74	1.494	0.0109598	190.437	7.232	1594.39	1.482	0.0068833	137.913	6.272
1385.81	1.494	0.0080118	139.523	7.216	1598.47	1.480	0.0064816	130.195	6.256
1388.89	1.495	0.0057985	101.203	7.200	1602.56	1.479	0.0052823	106.376	6.240
1391.98	1.497	0.0048990	85.694	7.184	1606.68	1.479	0.0030495	61.571	6.224
1395.09	1.498	0.0046868	82.165	7.168	1610.83	1.480	0.0024872	50.347	6.208
1398.21	1.500	0.0046425	81.571	7.152	1614.99	1.481	0.0020138	40.869	6.192
1401.35	1.501	0.0046059	81.109	7.136	1619.17	1.481	0.0018479	37.599	6.176
1404.49	1.503	0.0052360	92.412	7.120	1623.38	1.481	0.0015395	31.405	6.160
1407.66	1.504	0.0056752	100.390	7.104	1627.60	1.482	0.0011890	24.319	6.144
1410.84	1.506	0.0062374	110.584	7.088	1631.85	1.482	0.0008877	18.204	6.128
1414.03	1.507	0.0075527	134.205	7.072	1636.13	1.483	0.0007528	15.478	6.112
1417.23	1.508	0.0086736	154.472	7.056	1640.42	1.483	0.0008573	17.673	6.096
1420.46	1.510	0.0094662	168.972	7.040	1644.74	1.484	0.0010719	22.155	6.080
1423.69	1.514	0.0110249	197.243	7.024	1649.08	1.484	0.0011894	24.648	6.064
1426.94	1.516	0.0175600	314.876	7.008	1653.44	1.484	0.0011317	23.514	6.048
1430.21	1.515	0.0206852	371.766	6.992	1657.83	1.484	0.0011871	24.731	6.032
1433.49	1.515	0.0247245	445.381	6.976	1662.23	1.484	0.0013787	28.799	6.016
1436.78	1.513	0.0294349	531.451	6.960	1666.67	1.484	0.0016724	35.026	6.000
1440.09	1.511	0.0318613	576.585	6.944	1671.12	1.484	0.0018165	38.146	5.984
1443.42	1.509	0.0362879	658.210	6.928	1675.60	1.484	0.0016040	33.774	5.968
1446.76	1.506	0.0382960	696.241	6.912	1680.11	1.484	0.0011409	24.087	5.952
1450.12	1.503	0.0432692	788.484	6.896	1684.64	1.484	0.0007752	16.411	5.936
1453.49	1.498	0.0448215	818.670	6.880	1689.19	1.485	0.0007605	16.144	5.920
1456.88	1.491	0.0484783	887.526	6.864	1693.77	1.485	0.0010102	21.501	5.904
1460.28	1.482	0.0478089	877.314	6.848	1698.37	1.485	0.0011840	25.270	5.888
1463.70	1.474	0.0435993	801.940	6.832	1703.00	1.485	0.0011165	23.894	5.872
1467.14	1.469	0.0347388	640.466	6.816	1707.65	1.485	0.0009108	19.545	5.856

o-XYLENE					o-XYLENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1712.33	1.485	0.0008517	18.327	5.840	1931.99	1.488	0.0013562	32.927	5.176
1717.03	1.485	0.0008979	19.375	5.824	1934.99	1.488	0.0014680	35.695	5.168
1721.76	1.485	0.0009062	19.608	5.808	1937.98	1.487	0.0014708	35.818	5.160
1726.52	1.486	0.0007509	16.292	5.792	1940.99	1.487	0.0013966	34.066	5.152
1731.30	1.486	0.0005013	10.906	5.776	1944.01	1.487	0.0012938	31.606	5.144
1736.11	1.486	0.0004457	9.724	5.760	1947.04	1.487	0.0011428	27.961	5.136
1740.95	1.486	0.0006240	13.651	5.744	1950.08	1.487	0.0010257	25.135	5.128
1745.81	1.486	0.0007221	15.842	5.728	1953.13	1.487	0.0008859	21.743	5.120
1750.70	1.487	0.0007129	15.685	5.712	1956.18	1.487	0.0007322	17.999	5.112
1755.62	1.487	0.0006323	13.950	5.696	1959.25	1.487	0.0006172	15.197	5.104
1760.56	1.487	0.0007952	17.593	5.680	1962.32	1.487	0.0005337	13.162	5.096
1765.54	1.487	0.0012459	27.641	5.664	1965.41	1.487	0.0004724	11.666	5.088
1770.54	1.487	0.0017843	39.700	5.648	1968.50	1.487	0.0004317	10.678	5.080
1775.57	1.487	0.0021924	48.917	5.632	1971.61	1.487	0.0003958	9.805	5.072
1780.63	1.486	0.0022126	49.508	5.616	1974.72	1.487	0.0003714	9.217	5.064
1785.71	1.486	0.0017226	38.654	5.600	1977.85	1.488	0.0003499	8.696	5.056
1790.83	1.486	0.0011912	26.807	5.584	1980.98	1.488	0.0003294	8.201	5.048
1795.98	1.486	0.0008996	20.302	5.568	1984.13	1.488	0.0003024	7.540	5.040
1801.15	1.487	0.0007723	17.481	5.552	1987.28	1.488	0.0002809	7.014	5.032
1806.36	1.487	0.0006930	15.731	5.536	1990.45	1.488	0.0002649	6.625	5.024
1811.59	1.487	0.0007509	17.094	5.520	1993.62	1.488	0.0002419	6.061	5.016
1816.86	1.487	0.0010391	23.723	5.504	1996.81	1.488	0.0002280	5.722	5.008
1822.16	1.487	0.0012829	29.375	5.488	2000.00	1.488	0.0002176	5.469	5.000
1827.49	1.487	0.0011433	26.256	5.472	2003.21	1.488	0.0002099	5.285	4.992
1832.85	1.487	0.0008286	19.085	5.456	2006.42	1.488	0.0002110	5.320	4.984
1838.24	1.488	0.0007609	17.577	5.440	2009.65	1.488	0.0002111	5.330	4.976
1843.66	1.488	0.0010175	23.573	5.424	2012.88	1.488	0.0002088	5.281	4.968
1849.11	1.488	0.0013105	30.452	5.408	2016.13	1.488	0.0002072	5.250	4.960
1851.85	1.488	0.0011906	27.706	5.400	2019.39	1.488	0.0001986	5.039	4.952
1854.60	1.488	0.0013146	30.638	5.392	2022.65	1.488	0.0001930	4.905	4.944
1857.36	1.488	0.0013406	31.291	5.384	2025.93	1.488	0.0001863	4.744	4.936
1860.12	1.488	0.0013476	31.500	5.376	2029.22	1.488	0.0001811	4.617	4.928
1862.89	1.488	0.0012931	30.271	5.368	2032.52	1.488	0.0001788	4.567	4.920
1865.67	1.488	0.0012311	28.862	5.360	2035.83	1.488	0.0001765	4.515	4.912
1868.46	1.488	0.0012420	29.161	5.352	2039.15	1.488	0.0001714	4.391	4.904
1871.26	1.488	0.0012906	30.348	5.344	2042.48	1.488	0.0001655	4.248	4.896
1874.06	1.488	0.0014196	33.431	5.336	2045.83	1.488	0.0001512	3.886	4.888
1876.88	1.488	0.0015723	37.083	5.328	2049.18	1.488	0.0001339	3.448	4.880
1879.70	1.488	0.0016871	39.850	5.320	2052.55	1.488	0.0001205	3.107	4.872
1882.53	1.488	0.0018517	43.805	5.312	2055.92	1.488	0.0001068	2.759	4.864
1885.37	1.488	0.0020128	47.689	5.304	2059.31	1.489	0.0001008	2.607	4.856
1888.22	1.488	0.0021555	51.146	5.296	2062.71	1.489	0.0001025	2.658	4.848
1891.07	1.488	0.0023009	54.677	5.288	2066.12	1.489	0.0001056	2.742	4.840
1893.94	1.487	0.0024052	57.245	5.280	2069.54	1.489	0.0001153	2.998	4.832
1896.81	1.487	0.0023394	55.762	5.272	2072.97	1.489	0.0001254	3.265	4.824
1899.70	1.487	0.0022122	52.811	5.264	2076.41	1.489	0.0001301	3.396	4.816
1902.59	1.487	0.0019457	46.519	5.256	2079.87	1.489	0.0001401	3.662	4.808
1905.49	1.487	0.0016125	38.611	5.248	2083.33	1.489	0.0001461	3.826	4.800
1908.40	1.487	0.0013249	31.773	5.240	2086.81	1.489	0.0001567	4.109	4.792
1911.32	1.487	0.0010243	24.603	5.232	2090.30	1.489	0.0001722	4.524	4.784
1914.24	1.487	0.0008076	19.426	5.224	2093.80	1.489	0.0001879	4.943	4.776
1917.18	1.487	0.0007029	16.933	5.216	2097.32	1.489	0.0002092	5.513	4.768
1920.12	1.487	0.0006964	16.803	5.208	2100.84	1.489	0.0002240	5.913	4.760
1923.08	1.488	0.0007890	19.067	5.200	2104.38	1.489	0.0002307	6.102	4.752
1926.04	1.488	0.0009894	23.946	5.192	2107.93	1.489	0.0002294	6.077	4.744
1929.01	1.488	0.0011843	28.708	5.184	2111.49	1.489	0.0002114	5.608	4.736

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frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2115.06	1.489	0.0001870	4.971	4.728	2336.45	1.490	0.0002837	8.330	4.280
2118.64	1.489	0.0001572	4.186	4.720	2340.82	1.490	0.0002666	7.841	4.272
2122.24	1.489	0.0001308	3.487	4.712	2345.22	1.490	0.0002447	7.210	4.264
2125.85	1.489	0.0001120	2.991	4.704	2349.62	1.490	0.0002237	6.604	4.256
2129.47	1.489	0.0000996	2.665	4.696	2354.05	1.490	0.0001992	5.893	4.248
2133.11	1.489	0.0000947	2.537	4.688	2358.49	1.490	0.0001835	5.438	4.240
2136.75	1.489	0.0001000	2.686	4.680	2362.95	1.490	0.0001898	5.637	4.232
2140.41	1.489	0.0001088	2.925	4.672	2367.42	1.490	0.0001999	5.947	4.224
2144.08	1.489	0.0001164	3.137	4.664	2371.92	1.491	0.0002083	6.209	4.216
2147.77	1.489	0.0001262	3.407	4.656	2376.43	1.491	0.0002295	6.852	4.208
2151.46	1.489	0.0001330	3.597	4.648	2380.95	1.491	0.0002531	7.572	4.200
2155.17	1.489	0.0001369	3.708	4.640	2385.50	1.491	0.0002759	8.272	4.192
2158.90	1.489	0.0001325	3.594	4.632	2390.06	1.491	0.0003038	9.124	4.184
2162.63	1.489	0.0001328	3.609	4.624	2394.64	1.491	0.0003387	10.193	4.176
2166.38	1.489	0.0001299	3.537	4.616	2399.23	1.491	0.0003711	11.189	4.168
2170.14	1.489	0.0001290	3.517	4.608	2403.85	1.491	0.0004032	12.179	4.160
2173.91	1.489	0.0001379	3.767	4.600	2408.48	1.491	0.0004284	12.967	4.152
2177.70	1.489	0.0001514	4.143	4.592	2413.13	1.491	0.0004534	13.748	4.144
2181.50	1.490	0.0001728	4.736	4.584	2417.80	1.491	0.0004644	14.109	4.136
2185.32	1.490	0.0001989	5.462	4.576	2422.48	1.491	0.0004728	14.394	4.128
2189.14	1.490	0.0002244	6.173	4.568	2427.18	1.491	0.0004740	14.457	4.120
2192.98	1.490	0.0002446	6.742	4.560	2431.91	1.491	0.0004615	14.103	4.112
2196.84	1.490	0.0002578	7.116	4.552	2436.65	1.491	0.0004436	13.581	4.104
2200.70	1.490	0.0002594	7.173	4.544	2441.41	1.491	0.0004124	12.653	4.096
2204.59	1.490	0.0002565	7.107	4.536	2446.18	1.491	0.0003749	11.524	4.088
2208.48	1.490	0.0002434	6.754	4.528	2450.98	1.491	0.0003464	10.670	4.080
2212.39	1.490	0.0002255	6.269	4.520	2455.80	1.491	0.0003129	9.655	4.072
2216.31	1.490	0.0002148	5.982	4.512	2460.63	1.491	0.0002853	8.821	4.064
2220.25	1.490	0.0002035	5.678	4.504	2465.48	1.491	0.0002635	8.162	4.056
2224.20	1.490	0.0001897	5.302	4.496	2470.36	1.491	0.0002486	7.719	4.048
2228.16	1.490	0.0001802	5.047	4.488	2475.25	1.491	0.0002378	7.397	4.040
2232.14	1.490	0.0001671	4.688	4.480	2480.16	1.491	0.0002291	7.140	4.032
2236.14	1.490	0.0001582	4.445	4.472	2485.09	1.491	0.0002244	7.008	4.024
2240.14	1.490	0.0001568	4.414	4.464	2490.04	1.491	0.0002185	6.838	4.016
2244.17	1.490	0.0001618	4.563	4.456	2495.01	1.491	0.0002122	6.653	4.008
2248.20	1.490	0.0001743	4.923	4.448	2500.00	1.491	0.0002070	6.502	4.000
2252.25	1.490	0.0001965	5.563	4.440	2505.01	1.491	0.0001980	6.234	3.992
2256.32	1.490	0.0002216	6.284	4.432	2510.04	1.491	0.0001861	5.870	3.984
2260.40	1.490	0.0002455	6.973	4.424	2515.09	1.491	0.0001765	5.580	3.976
2264.49	1.490	0.0002675	7.614	4.416	2520.16	1.491	0.0001733	5.489	3.968
2268.60	1.490	0.0002793	7.963	4.408	2525.25	1.491	0.0001752	5.559	3.960
2272.73	1.490	0.0002737	7.818	4.400	2530.36	1.491	0.0001823	5.797	3.952
2276.87	1.490	0.0002620	7.497	4.392	2535.50	1.491	0.0002023	6.447	3.944
2281.02	1.490	0.0002434	6.977	4.384	2540.65	1.491	0.0002358	7.529	3.936
2285.19	1.490	0.0002255	6.476	4.376	2545.83	1.492	0.0002766	8.848	3.928
2289.38	1.490	0.0002253	6.483	4.368	2551.02	1.492	0.0003248	10.413	3.920
2293.58	1.490	0.0002222	6.405	4.360	2556.24	1.492	0.0003761	12.080	3.912
2297.79	1.490	0.0002308	6.663	4.352	2561.48	1.492	0.0004190	13.486	3.904
2302.03	1.490	0.0002402	6.948	4.344	2566.74	1.492	0.0004423	14.267	3.896
2306.27	1.490	0.0002522	7.310	4.336	2572.02	1.492	0.0004422	14.291	3.888
2310.54	1.490	0.0002656	7.712	4.328	2577.32	1.492	0.0004262	13.802	3.880
2314.82	1.490	0.0002784	8.099	4.320	2582.65	1.492	0.0003952	12.826	3.872
2319.11	1.490	0.0002831	8.251	4.312	2587.99	1.492	0.0003612	11.746	3.864
2323.42	1.490	0.0002924	8.538	4.304	2593.36	1.492	0.0003328	10.846	3.856
2327.75	1.490	0.0002952	8.636	4.296	2598.75	1.492	0.0003047	9.950	3.848
2332.09	1.490	0.0003035	8.896	4.288	2604.17	1.492	0.0002758	9.025	3.840

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frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2609.60	1.492	0.0002497	8.188	3.832	2962.09	1.486	0.0104804	390.110	3.376
2615.06	1.492	0.0002295	7.542	3.824	2969.12	1.485	0.0093532	348.979	3.368
2620.55	1.492	0.0002116	6.967	3.816	2976.19	1.485	0.0083118	310.859	3.360
2626.05	1.492	0.0002013	6.642	3.808	2983.29	1.486	0.0075775	284.076	3.352
2631.58	1.492	0.0001992	6.588	3.800	2990.43	1.486	0.0071108	267.216	3.344
2637.13	1.492	0.0001999	6.625	3.792	2997.60	1.486	0.0069331	261.163	3.336
2642.71	1.492	0.0002102	6.981	3.784	3004.81	1.486	0.0069508	262.460	3.328
2648.31	1.492	0.0002251	7.492	3.776	3012.05	1.486	0.0070077	265.243	3.320
2653.93	1.492	0.0002415	8.054	3.768	3019.32	1.486	0.0070725	268.343	3.312
2659.57	1.493	0.0002596	8.675	3.760	3026.63	1.486	0.0071877	273.376	3.304
2665.25	1.493	0.0002803	9.389	3.752	3033.98	1.486	0.0072338	275.795	3.296
2670.94	1.493	0.0002982	10.010	3.744	3041.36	1.485	0.0070597	269.813	3.288
2676.66	1.493	0.0002979	10.019	3.736	3048.78	1.484	0.0067485	258.551	3.280
2682.40	1.493	0.0003252	10.962	3.728	3056.24	1.484	0.0061388	235.768	3.272
2688.17	1.493	0.0003623	12.239	3.720	3063.73	1.483	0.0053160	204.666	3.264
2693.97	1.493	0.0004155	14.067	3.712	3071.25	1.483	0.0042053	162.302	3.256
2699.78	1.493	0.0004814	16.333	3.704	3078.82	1.483	0.0037802	146.256	3.248
2705.63	1.493	0.0005699	19.376	3.696	3086.42	1.483	0.0029857	115.801	3.240
2711.50	1.494	0.0006673	22.737	3.688	3094.06	1.483	0.0023021	89.510	3.232
2717.39	1.494	0.0007793	26.610	3.680	3101.74	1.484	0.0016984	66.198	3.224
2723.31	1.494	0.0010813	37.006	3.672	3109.45	1.484	0.0012075	47.182	3.216
2729.26	1.494	0.0010688	36.657	3.664	3117.21	1.485	0.0009363	36.678	3.208
2735.23	1.494	0.0010229	35.159	3.656	3125.00	1.485	0.0007213	28.326	3.200
2741.23	1.494	0.0009467	32.610	3.648	3132.83	1.485	0.0006253	24.616	3.192
2747.25	1.494	0.0008801	30.384	3.640	3140.70	1.486	0.0005340	21.076	3.184
2753.30	1.494	0.0008180	28.300	3.632	3148.62	1.486	0.0004591	18.165	3.176
2759.38	1.494	0.0008020	27.810	3.624	3156.57	1.486	0.0003850	15.270	3.168
2765.49	1.494	0.0008048	29.970	3.616	3164.56	1.486	0.0003257	12.952	3.160
2771.62	1.495	0.0008407	29.281	3.608	3172.59	1.486	0.0002812	11.210	3.152
2777.78	1.495	0.0008884	31.012	3.600	3180.66	1.487	0.0002295	9.173	3.144
2783.96	1.495	0.0009811	34.324	3.592	3188.78	1.487	0.0001973	7.907	3.136
2790.18	1.495	0.0010919	38.284	3.584	3196.93	1.487	0.0001638	6.582	3.128
2796.42	1.496	0.0012478	43.850	3.576	3205.13	1.487	0.0001330	5.355	3.120
2802.69	1.496	0.0015770	55.543	3.568	3213.37	1.487	0.0001077	4.347	3.112
2808.99	1.496	0.0016875	59.565	3.560	3221.65	1.487	0.0000842	3.410	3.104
2815.32	1.497	0.0020008	70.784	3.552	3229.97	1.487	0.0000701	2.845	3.096
2821.67	1.497	0.0023471	83.225	3.544	3238.34	1.488	0.0000576	2.343	3.088
2828.05	1.498	0.0028272	100.473	3.536	3246.75	1.488	0.0000476	1.943	3.080
2834.47	1.499	0.0037690	134.249	3.528	3255.21	1.488	0.0000422	1.724	3.072
2840.91	1.499	0.0049983	178.438	3.520	3263.71	1.488	0.0000409	1.678	3.064
2847.38	1.498	0.0063701	227.929	3.512	3272.25	1.488	0.0000375	1.541	3.056
2860.41	1.497	0.0068598	246.574	3.496	3280.84	1.488	0.0000361	1.488	3.048
2866.97	1.497	0.0074210	267.358	3.488	3298.15	1.488	0.0000345	1.430	3.032
2873.56	1.497	0.0078678	284.107	3.480	3306.88	1.488	0.0000339	1.408	3.024
2880.18	1.497	0.0080739	292.220	3.472	3342.25	1.489	0.0000355	1.493	2.992
2886.84	1.497	0.0086350	313.254	3.464	3351.21	1.489	0.0000352	1.484	2.984
2893.52	1.497	0.0094286	342.833	3.456	3360.22	1.489	0.0000336	1.421	2.976
2900.23	1.497	0.0104396	380.477	3.448	3369.27	1.489	0.0000337	1.425	2.968
2906.98	1.496	0.0116085	424.061	3.440	3387.53	1.489	0.0000339	1.444	2.952
2913.75	1.496	0.0128537	470.642	3.432	3396.74	1.489	0.0000378	1.612	2.944
2920.56	1.494	0.0137857	505.948	3.424	3406.00	1.489	0.0000430	1.839	2.936
2927.40	1.492	0.0142668	524.831	3.416	3415.30	1.489	0.0000479	2.058	2.928
2934.27	1.491	0.0142513	525.492	3.408	3424.66	1.489	0.0000548	2.357	2.920
2941.18	1.489	0.0136506	504.526	3.400	3434.07	1.489	0.0000611	2.635	2.912
2948.11	1.487	0.0127282	471.541	3.392	3443.53	1.489	0.0000637	2.756	2.904
2955.08	1.486	0.0116096	431.118	3.384	3453.04	1.489	0.0000645	2.799	2.896

o-XYLENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3462.60	1.489	0.0000635	2.763	2.888
3472.22	1.489	0.0000592	2.582	2.880
3481.89	1.489	0.0000544	2.379	2.872
3491.62	1.489	0.0000520	2.282	2.864
3501.40	1.489	0.0000500	2.201	2.856
3511.24	1.489	0.0000517	2.281	2.848
3521.13	1.489	0.0000558	2.469	2.840
3531.07	1.489	0.0000634	2.813	2.832
3541.08	1.490	0.0000717	3.192	2.824
3551.14	1.490	0.0000800	3.570	2.816
3561.25	1.490	0.0000883	3.953	2.808
3571.43	1.490	0.0000937	4.206	2.800
3581.66	1.490	0.0000952	4.285	2.792
3591.95	1.490	0.0000925	4.175	2.784
3602.31	1.490	0.0000888	4.018	2.776
3612.72	1.490	0.0000828	3.761	2.768
3623.19	1.490	0.0000789	3.593	2.760
3633.72	1.490	0.0000750	3.424	2.752
3644.32	1.490	0.0000721	3.303	2.744
3654.97	1.490	0.0000710	3.259	2.736
3665.69	1.490	0.0000707	3.257	2.728
3676.47	1.490	0.0000734	3.391	2.720
3687.32	1.490	0.0000759	3.517	2.712
3698.23	1.490	0.0000814	3.783	2.704
3709.20	1.490	0.0000882	4.111	2.696
3720.24	1.490	0.0000976	4.564	2.688
3731.34	1.490	0.0001065	4.994	2.680
3742.52	1.490	0.0001179	5.547	2.672
3753.75	1.490	0.0001263	5.960	2.664
3765.06	1.490	0.0001370	6.482	2.656
3776.44	1.490	0.0001509	7.162	2.648
3787.88	1.490	0.0001645	7.830	2.640
3799.39	1.490	0.0001980	9.453	2.632
3810.98	1.490	0.0002035	9.746	2.624
3822.63	1.490	0.0002267	10.891	2.616
3834.36	1.490	0.0002521	12.145	2.608
3846.15	1.490	0.0002751	13.296	2.600
3858.03	1.490	0.0002945	14.277	2.592
3869.97	1.490	0.0003086	15.005	2.584
3881.99	1.490	0.0003057	14.913	2.576
3894.08	1.490	0.0003072	15.031	2.568
3906.25	1.490	0.0003106	15.245	2.560
4000.00	1.490	0.0002597	13.051	2.500
4081.71	1.490	0.0003645	18.697	2.450
4127.65	1.491	0.0002865	14.859	2.423
4322.26	1.491	0.0005509	29.922	2.314
4564.36	1.491	0.0001261	7.234	2.191
4621.88	1.491	0.0001947	11.311	2.164
4867.27	1.491	0.0000393	2.401	2.055
5000.00	1.491	0.0000215	1.353	2.000

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
400.00	1.512	0.0012034	6.049	25.000	723.38	1.739	0.3172237	2883.646	13.824
416.67	1.520	0.0011552	6.049	24.000	724.22	1.684	0.3208983	2920.437	13.808
454.55	1.553	0.0213718	122.076	22.000	725.06	1.665	0.3470906	3162.472	13.792
461.68	1.598	0.0628917	364.875	21.660	725.90	1.650	0.3626313	3307.897	13.776
464.04	1.637	0.1122380	654.493	21.550	726.74	1.681	0.3867745	3532.212	13.760
466.42	1.539	0.2642135	1548.610	21.440	727.59	1.659	0.5542137	5067.268	13.744
468.82	1.389	0.1110937	654.493	21.330	728.44	1.461	0.6707810	6140.227	13.728
471.25	1.407	0.0616146	364.875	21.220	729.29	1.254	0.5529218	5067.268	13.712
476.19	1.433	0.0135909	81.328	21.000	730.14	1.215	0.3849734	3532.212	13.696
480.19	1.456	0.0087269	52.660	20.825	730.99	1.232	0.3504152	3218.876	13.680
486.62	1.470	0.0048009	29.358	20.550	731.85	1.198	0.3130366	2878.903	13.664
504.41	1.487	0.0020232	12.824	19.825	732.71	1.200	0.2153587	1982.916	13.648
510.07	1.491	0.0013816	8.855	19.605	733.57	1.237	0.1948556	1796.240	13.632
514.40	1.494	0.0019839	12.824	19.440	734.43	1.242	0.1873224	1728.821	13.616
517.33	1.496	0.0027979	18.189	19.330	735.29	1.238	0.1568875	1449.629	13.600
518.81	1.497	0.0045030	29.358	19.275	736.16	1.254	0.1254867	1160.860	13.584
521.78	1.494	0.0074260	48.691	19.165	737.03	1.267	0.1206934	1117.837	13.568
524.80	1.492	0.0044516	29.358	19.055	737.90	1.273	0.1021372	947.090	13.552
526.32	1.493	0.0032774	21.676	19.000	738.77	1.285	0.0894623	830.538	13.536
531.21	1.495	0.0019211	12.824	18.825	739.65	1.298	0.0823550	765.466	13.520
540.69	1.498	0.0014456	9.822	18.495	740.52	1.304	0.0807245	751.193	13.504
545.55	1.499	0.0010166	6.969	18.330	741.40	1.307	0.0735605	685.342	13.488
555.56	1.502	0.0008013	5.594	18.000	742.28	1.313	0.0648572	604.973	13.472
588.24	1.511	0.0005751	4.251	17.000	743.16	1.321	0.0608106	567.899	13.456
602.23	1.516	0.0006796	5.143	16.605	744.05	1.326	0.0586860	548.715	13.440
606.24	1.518	0.0009148	6.969	16.495	744.93	1.328	0.0582328	545.121	13.424
614.44	1.522	0.0016609	12.824	16.275	745.82	1.326	0.0559815	524.672	13.408
618.62	1.524	0.0026358	20.490	16.165	746.71	1.316	0.0509152	477.759	13.392
622.86	1.528	0.0035778	28.004	16.055	747.61	1.321	0.0195328	183.505	13.376
631.91	1.523	0.0140762	111.777	15.825	748.50	1.339	0.0176680	166.184	13.360
636.33	1.522	0.0019980	15.977	15.715	749.40	1.347	0.0168654	158.826	13.344
638.57	1.528	0.0021275	17.072	15.660	750.30	1.353	0.0139208	131.253	13.328
647.67	1.537	0.0026633	21.676	15.440	751.20	1.360	0.0124333	117.369	13.312
657.03	1.569	0.0035557	29.358	15.220	752.11	1.364	0.0123584	116.803	13.296
691.39	1.571	0.1323163	1149.599	14.464	753.01	1.369	0.0086593	81.940	13.280
694.01	1.612	0.2160631	1884.327	14.409	754.83	1.378	0.0074465	70.633	13.248
696.65	1.421	0.1313173	1149.599	14.354	755.74	1.382	0.0060466	57.424	13.232
699.30	1.415	0.0744787	654.493	14.300	756.66	1.386	0.0056949	54.150	13.216
701.98	1.443	0.0413628	364.875	14.245	757.58	1.389	0.0046525	44.292	13.200
706.03	1.491	0.0223809	198.568	14.164	758.50	1.392	0.0042925	40.914	13.184
708.76	1.523	0.0207944	185.206	14.109	759.42	1.395	0.0033240	31.721	13.168
711.51	1.562	0.0222085	198.568	14.055	760.34	1.399	0.0028690	27.412	13.152
714.29	1.597	0.0510505	458.231	14.000	761.27	1.402	0.0027928	26.717	13.136
715.10	1.603	0.0574212	515.999	13.984	764.06	1.409	0.0024554	23.575	13.088
715.92	1.608	0.0645809	581.003	13.968	765.93	1.414	0.0027279	26.256	13.056
716.74	1.618	0.0631912	569.152	13.952	766.87	1.416	0.0029660	28.583	13.040
717.57	1.636	0.0725130	653.868	13.936	767.81	1.418	0.0032916	31.759	13.024
718.39	1.649	0.0885638	799.515	13.920	768.76	1.420	0.0036826	35.576	13.008
719.22	1.659	0.0983393	888.789	13.904	769.70	1.421	0.0037604	36.372	12.992
720.05	1.681	0.1059529	958.706	13.888	770.65	1.423	0.0041561	40.249	12.976
720.88	1.700	0.1416926	1283.571	13.872	771.60	1.424	0.0043552	42.229	12.960
721.71	1.718	0.1566779	1420.955	13.856	772.56	1.425	0.0046451	45.096	12.944
722.54	1.760	0.2004728	1820.234	13.840	773.51	1.427	0.0045276	44.009	12.928
					774.47	1.428	0.0051255	49.883	12.912
					775.43	1.429	0.0052819	51.468	12.896
					776.40	1.430	0.0051651	50.393	12.880

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
777.36	1.431	0.0058391	57.040	12.864	869.26	1.467	0.0023226	25.370	11.504
778.33	1.432	0.0058350	57.071	12.848	870.47	1.467	0.0021056	23.033	11.488
779.30	1.433	0.0062588	61.292	12.832	871.69	1.467	0.0021046	23.054	11.472
780.27	1.433	0.0072978	71.557	12.816	872.91	1.467	0.0020284	22.250	11.456
781.25	1.434	0.0068750	67.495	12.800	874.13	1.468	0.0018903	20.765	11.440
782.23	1.434	0.0081066	79.686	12.784	875.35	1.468	0.0019549	21.504	11.424
783.21	1.434	0.0082422	81.121	12.768	876.58	1.468	0.0020403	22.475	11.408
784.19	1.434	0.0073164	72.099	12.752	877.81	1.469	0.0020727	22.864	11.392
785.18	1.434	0.0074215	73.227	12.736	879.04	1.469	0.0021576	23.833	11.376
786.16	1.434	0.0063087	62.325	12.720	880.28	1.469	0.0023223	25.690	11.360
787.15	1.435	0.0053795	53.212	12.704	881.52	1.470	0.0023056	25.540	11.344
788.15	1.435	0.0050283	49.801	12.688	882.77	1.470	0.0024866	27.585	11.328
789.14	1.436	0.0035076	34.783	12.672	884.02	1.470	0.0026525	29.467	11.312
790.14	1.437	0.0036023	35.767	12.656	885.27	1.471	0.0029290	32.584	11.296
791.14	1.438	0.0031231	31.049	12.640	886.52	1.471	0.0032282	35.963	11.280
792.14	1.439	0.0029988	29.851	12.624	887.78	1.472	0.0039936	44.553	11.264
793.15	1.440	0.0029052	28.956	12.608	889.05	1.472	0.0045504	50.838	11.248
794.16	1.441	0.0025227	25.176	12.592	890.31	1.472	0.0054829	61.343	11.232
795.17	1.441	0.0023138	23.121	12.576	891.58	1.471	0.0066645	74.668	11.216
796.18	1.442	0.0021310	21.320	12.560	895.42	1.468	0.0064885	73.010	11.168
798.21	1.444	0.0020344	20.406	12.528	896.70	1.468	0.0053144	59.885	11.152
806.45	1.449	0.0019310	19.569	12.400	897.99	1.468	0.0045582	51.437	11.136
814.86	1.453	0.0018386	18.827	12.272	899.28	1.468	0.0042037	47.504	11.120
818.06	1.454	0.0018109	18.616	12.224	900.58	1.468	0.0035228	39.867	11.104
826.72	1.458	0.0018858	19.591	12.096	901.88	1.469	0.0033923	38.446	11.088
827.81	1.458	0.0022521	23.428	12.080	903.18	1.469	0.0030955	35.133	11.072
828.91	1.459	0.0023160	24.125	12.064	904.49	1.469	0.0029860	33.939	11.056
830.01	1.459	0.0023475	24.484	12.048	905.80	1.469	0.0027667	31.492	11.040
831.12	1.459	0.0025672	26.813	12.032	907.11	1.469	0.0026551	30.266	11.024
832.22	1.459	0.0026246	27.448	12.016	908.43	1.470	0.0023889	27.271	11.008
833.33	1.460	0.0025797	27.014	12.000	909.75	1.470	0.0022252	25.440	10.992
834.45	1.460	0.0025970	27.232	11.984	911.08	1.470	0.0021445	24.552	10.976
835.56	1.460	0.0029327	30.793	11.968	915.08	1.471	0.0021189	24.366	10.928
836.68	1.461	0.0029473	30.988	11.952	917.77	1.472	0.0022086	25.472	10.896
837.80	1.461	0.0032070	33.764	11.936	919.12	1.472	0.0021701	25.064	10.880
838.93	1.461	0.0036048	38.003	11.920	921.83	1.472	0.0021857	25.320	10.848
840.05	1.461	0.0035538	37.515	11.904	923.19	1.472	0.0021568	25.022	10.832
841.18	1.461	0.0036254	38.322	11.888	924.56	1.473	0.0022595	26.251	10.816
843.45	1.461	0.0035702	37.841	11.856	925.93	1.473	0.0023629	27.494	10.800
844.59	1.461	0.0031464	33.395	11.840	927.30	1.473	0.0023972	27.934	10.784
845.74	1.461	0.0030335	32.240	11.824	928.68	1.473	0.0025389	29.629	10.768
846.88	1.461	0.0027834	29.621	11.808	931.45	1.473	0.0025102	29.381	10.736
848.03	1.461	0.0023603	25.153	11.792	932.84	1.473	0.0025573	29.978	10.720
850.34	1.462	0.0022777	24.339	11.760	934.23	1.474	0.0024866	29.192	10.704
852.66	1.463	0.0021732	23.286	11.728	935.63	1.474	0.0023936	28.143	10.688
853.83	1.463	0.0022123	23.737	11.712	937.03	1.474	0.0024803	29.205	10.672
854.99	1.463	0.0020388	21.905	11.696	938.44	1.474	0.0024700	29.129	10.656
856.16	1.464	0.0020084	21.608	11.680	939.85	1.474	0.0025831	30.507	10.640
857.34	1.464	0.0019225	20.712	11.664	941.27	1.474	0.0027832	32.921	10.624
858.52	1.464	0.0017258	18.618	11.648	942.68	1.474	0.0027843	32.983	10.608
862.07	1.465	0.0016909	18.318	11.600	944.11	1.474	0.0028617	33.951	10.592
863.26	1.466	0.0016889	18.321	11.584	945.54	1.474	0.0021834	25.943	10.576
864.45	1.466	0.0019146	20.798	11.568	946.97	1.475	0.0019488	23.191	10.560
865.65	1.466	0.0020910	22.746	11.552	948.41	1.475	0.0020102	23.957	10.544
866.85	1.466	0.0020921	22.790	11.536	951.29	1.476	0.0020894	24.977	10.512
868.06	1.467	0.0022685	24.746	11.520	952.74	1.476	0.0021758	26.050	10.496

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
954.20	1.477	0.0025213	30.232	10.480	1057.53	1.476	0.0038310	50.912	9.456
955.66	1.477	0.0032619	39.173	10.464	1059.32	1.478	0.0042334	56.354	9.440
957.12	1.477	0.0033552	40.355	10.448	1061.12	1.478	0.0044907	59.881	9.424
958.59	1.477	0.0036061	43.439	10.432	1062.93	1.480	0.0045541	60.830	9.408
960.06	1.477	0.0041888	50.536	10.416	1064.74	1.481	0.0054411	72.801	9.392
961.54	1.477	0.0042206	50.998	10.400	1066.55	1.483	0.0072150	96.701	9.376
963.02	1.477	0.0045423	54.970	10.384	1068.38	1.484	0.0083326	111.870	9.360
964.51	1.476	0.0044037	53.374	10.368	1070.21	1.485	0.0111401	149.820	9.344
966.00	1.476	0.0041241	50.063	10.352	1072.04	1.485	0.0137478	185.206	9.328
967.49	1.476	0.0041246	50.146	10.336	1073.88	1.485	0.0174074	234.909	9.312
968.99	1.476	0.0033883	41.259	10.320	1075.73	1.484	0.0217603	294.157	9.296
972.01	1.477	0.0033202	40.555	10.288	1077.59	1.476	0.0319017	431.994	9.280
975.04	1.477	0.0035373	43.342	10.256	1079.45	1.464	0.0252881	343.027	9.264
978.09	1.478	0.0034694	42.642	10.224	1081.32	1.461	0.0175946	239.080	9.248
981.16	1.478	0.0034862	42.984	10.192	1083.19	1.461	0.0131613	179.148	9.232
984.25	1.479	0.0034582	42.772	10.160	1085.07	1.462	0.0089581	122.147	9.216
985.80	1.479	0.0041550	51.472	10.144	1086.96	1.463	0.0062244	85.020	9.200
987.36	1.479	0.0043072	53.441	10.128	1088.85	1.465	0.0046935	64.221	9.184
988.92	1.478	0.0041936	52.114	10.112	1090.75	1.467	0.0031569	43.270	9.168
993.64	1.479	0.0040679	50.793	10.064	1100.35	1.472	0.0035222	48.703	9.088
995.22	1.479	0.0037622	47.051	10.048	1102.29	1.472	0.0038151	52.846	9.072
998.40	1.479	0.0034642	43.463	10.016	1104.24	1.472	0.0036204	50.238	9.056
1000.00	1.479	0.0033814	42.492	10.000	1106.20	1.471	0.0030563	42.485	9.040
1001.60	1.480	0.0028824	36.280	9.984	1108.16	1.472	0.0022885	31.868	9.024
1003.21	1.481	0.0028690	36.169	9.968	1114.08	1.474	0.0022401	31.362	8.976
1004.82	1.481	0.0028822	36.393	9.952	1116.07	1.474	0.0023527	32.996	8.960
1006.44	1.482	0.0029863	37.769	9.936	1118.07	1.474	0.0025869	36.346	8.944
1008.07	1.483	0.0034340	43.501	9.920	1120.07	1.475	0.0026909	37.875	8.928
1009.69	1.484	0.0041142	52.201	9.904	1122.08	1.475	0.0028238	39.816	8.912
1011.33	1.484	0.0044424	56.458	9.888	1124.10	1.475	0.0026286	37.132	8.896
1012.97	1.485	0.0047309	60.222	9.872	1126.13	1.475	0.0024723	34.986	8.880
1014.61	1.486	0.0056869	72.508	9.856	1128.16	1.475	0.0023204	32.897	8.864
1016.26	1.486	0.0062214	79.452	9.840	1130.20	1.475	0.0018077	25.674	8.848
1017.92	1.487	0.0062891	80.447	9.824	1132.25	1.476	0.0020851	29.667	8.832
1019.58	1.489	0.0081172	104.001	9.808	1136.36	1.476	0.0021195	30.266	8.800
1021.24	1.491	0.0097167	124.697	9.792	1140.51	1.477	0.0022610	32.404	8.768
1022.91	1.492	0.0133134	171.135	9.776	1142.60	1.477	0.0024005	34.467	8.752
1024.59	1.492	0.0189074	243.440	9.760	1144.69	1.477	0.0029063	41.805	8.736
1026.27	1.488	0.0252632	325.807	9.744	1146.79	1.477	0.0032631	47.025	8.720
1027.96	1.480	0.0267765	345.892	9.728	1148.90	1.476	0.0033116	47.811	8.704
1029.65	1.474	0.0231261	299.228	9.712	1151.01	1.476	0.0013478	19.495	8.688
1031.35	1.472	0.0182985	237.154	9.696	1153.14	1.477	0.0018446	26.729	8.672
1033.06	1.473	0.0153877	199.760	9.680	1155.27	1.478	0.0018861	27.381	8.656
1034.77	1.474	0.0150840	196.142	9.664	1157.41	1.478	0.0020435	29.722	8.640
1036.48	1.473	0.0160663	209.260	9.648	1159.56	1.479	0.0026040	37.944	8.624
1038.21	1.472	0.0148558	193.817	9.632	1161.71	1.479	0.0025995	37.949	8.608
1039.93	1.471	0.0152616	199.440	9.616	1163.87	1.479	0.0030827	45.086	8.592
1041.67	1.470	0.0123775	162.022	9.600	1166.05	1.480	0.0036301	53.192	8.576
1043.41	1.469	0.0114594	150.254	9.584	1168.22	1.480	0.0043887	64.428	8.560
1045.15	1.469	0.0093384	122.648	9.568	1170.41	1.480	0.0057288	84.258	8.544
1046.90	1.470	0.0074229	97.654	9.552	1172.61	1.479	0.0073244	107.929	8.528
1048.66	1.470	0.0063674	83.908	9.536	1174.81	1.477	0.0078588	116.021	8.512
1050.42	1.472	0.0048228	63.661	9.520	1177.02	1.475	0.0074889	110.768	8.496
1052.19	1.473	0.0042958	56.800	9.504	1179.25	1.474	0.0058261	86.336	8.480
1053.96	1.474	0.0044106	58.416	9.488	1181.47	1.474	0.0039915	59.261	8.464
1055.74	1.475	0.0042462	56.334	9.472	1183.71	1.475	0.0029515	43.904	8.448

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1188.21	1.476	0.0026299	39.268	8.416	1379.69	1.485	0.0062534	108.419	7.248
1190.48	1.476	0.0024887	37.231	8.400	1382.74	1.485	0.0052656	91.495	7.232
1192.75	1.476	0.0022559	33.813	8.384	1385.81	1.485	0.0046123	80.322	7.216
1199.62	1.477	0.0022642	34.133	8.336	1391.98	1.486	0.0047418	82.945	7.184
1201.92	1.478	0.0025406	38.372	8.320	1395.09	1.487	0.0046412	81.367	7.168
1204.24	1.478	0.0027923	42.256	8.304	1398.21	1.487	0.0044597	78.360	7.152
1206.56	1.477	0.0030553	46.325	8.288	1401.35	1.488	0.0044702	78.719	7.136
1208.90	1.477	0.0028838	43.810	8.272	1404.49	1.488	0.0045341	80.024	7.120
1211.24	1.477	0.0021434	32.625	8.256	1407.66	1.489	0.0045296	80.126	7.104
1213.59	1.477	0.0015827	24.136	8.240	1410.84	1.490	0.0052292	92.709	7.088
1215.95	1.478	0.0020595	31.470	8.224	1414.03	1.491	0.0056802	100.932	7.072
1220.70	1.477	0.0018106	27.774	8.192	1417.23	1.492	0.0066617	118.641	7.056
1223.09	1.477	0.0016215	24.922	8.176	1420.46	1.492	0.0073849	131.821	7.040
1225.49	1.478	0.0012549	19.325	8.160	1423.69	1.493	0.0081307	145.463	7.024
1232.74	1.479	0.0010929	16.931	8.112	1426.94	1.494	0.0081442	146.038	7.008
1235.18	1.479	0.0012020	18.658	8.096	1430.21	1.497	0.0092361	165.996	6.992
1237.62	1.479	0.0013123	20.410	8.080	1433.49	1.499	0.0136264	245.462	6.976
1240.08	1.479	0.0013191	20.556	8.064	1436.78	1.498	0.0189580	342.289	6.960
1242.55	1.479	0.0013589	21.218	8.048	1440.09	1.496	0.0210575	381.072	6.944
1250.00	1.479	0.0012680	19.917	8.000	1443.42	1.495	0.0235508	427.177	6.928
1252.51	1.479	0.0011072	17.426	7.984	1446.76	1.492	0.0265855	483.338	6.912
1262.63	1.480	0.0009699	15.389	7.920	1450.12	1.489	0.0292025	532.150	6.896
1265.18	1.480	0.0009612	15.282	7.904	1453.49	1.484	0.0305077	557.225	6.880
1270.33	1.481	0.0010129	16.169	7.872	1456.88	1.479	0.0293837	537.947	6.864
1275.51	1.481	0.0010165	16.293	7.840	1460.28	1.475	0.0264148	484.724	6.848
1278.12	1.481	0.0009313	14.958	7.824	1463.70	1.473	0.0231717	426.207	6.832
1283.37	1.481	0.0009234	14.892	7.792	1467.14	1.472	0.0192464	354.838	6.816
1286.01	1.482	0.0010924	17.654	7.776	1470.59	1.473	0.0162138	299.631	6.800
1288.66	1.482	0.0011026	17.856	7.760	1474.06	1.475	0.0139885	259.117	6.784
1291.32	1.482	0.0011052	17.934	7.744	1477.54	1.479	0.0130021	241.415	6.768
1294.00	1.482	0.0011611	18.880	7.728	1481.04	1.483	0.0157138	292.455	6.752
1296.68	1.482	0.0012889	21.002	7.712	1484.56	1.485	0.0239237	446.310	6.736
1299.38	1.482	0.0014646	23.914	7.696	1488.10	1.477	0.0335276	626.966	6.720
1302.08	1.483	0.0014799	24.215	7.680	1491.65	1.465	0.0318722	597.433	6.704
1304.80	1.483	0.0016106	26.408	7.664	1495.22	1.457	0.0222241	417.580	6.688
1307.53	1.483	0.0018001	29.577	7.648	1498.80	1.458	0.0111403	209.822	6.672
1310.27	1.483	0.0018227	30.012	7.632	1502.40	1.462	0.0099568	187.981	6.656
1313.03	1.483	0.0017616	29.067	7.616	1506.02	1.465	0.0066599	126.040	6.640
1315.79	1.483	0.0016596	27.442	7.600	1509.66	1.467	0.0067479	128.015	6.624
1318.57	1.483	0.0016077	26.640	7.584	1513.32	1.468	0.0072551	137.969	6.608
1321.35	1.483	0.0017010	28.245	7.568	1516.99	1.468	0.0068313	130.225	6.592
1324.15	1.484	0.0018543	30.856	7.552	1520.68	1.469	0.0063718	121.762	6.576
1326.96	1.484	0.0018449	30.763	7.536	1524.39	1.469	0.0054857	105.084	6.560
1329.79	1.484	0.0018424	30.788	7.520	1528.12	1.470	0.0048326	92.799	6.544
1332.62	1.484	0.0018686	31.292	7.504	1531.86	1.470	0.0041794	80.453	6.528
1335.47	1.484	0.0018611	31.232	7.488	1535.63	1.471	0.0034721	67.001	6.512
1338.33	1.485	0.0019076	32.081	7.472	1539.41	1.472	0.0033166	64.160	6.496
1341.20	1.485	0.0020254	34.136	7.456	1543.21	1.473	0.0034418	66.745	6.480
1344.09	1.485	0.0020245	34.194	7.440	1550.87	1.474	0.0034189	66.631	6.448
1346.98	1.486	0.0021915	37.094	7.424	1554.73	1.474	0.0033801	66.039	6.432
1349.89	1.486	0.0025317	42.945	7.408	1558.60	1.475	0.0036842	72.159	6.416
1352.81	1.486	0.0026982	45.869	7.392	1562.50	1.475	0.0042158	82.778	6.400
1358.70	1.487	0.0026980	46.065	7.360	1566.42	1.475	0.0045468	89.501	6.384
1361.66	1.488	0.0034214	58.544	7.344	1570.35	1.475	0.0047108	92.960	6.368
1364.63	1.488	0.0043074	73.866	7.328	1578.28	1.476	0.0046927	93.071	6.336
1367.62	1.488	0.0059205	101.749	7.312	1582.28	1.476	0.0050312	100.039	6.320

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
1586.29	1.476	0.0053452	106.550	6.304	1871.26	1.478	0.0017875	42.033	5.344
1590.33	1.477	0.0068195	136.285	6.288	1874.06	1.478	0.0015981	37.635	5.336
1594.39	1.475	0.0084256	168.813	6.272	1876.88	1.478	0.0013705	32.324	5.328
1598.47	1.473	0.0082956	166.634	6.256	1879.70	1.478	0.0011679	27.588	5.320
1602.56	1.471	0.0069319	139.596	6.240	1882.53	1.478	0.0009542	22.572	5.312
1606.68	1.471	0.0049858	100.663	6.224	1885.37	1.478	0.0006980	16.536	5.304
1610.83	1.472	0.0039147	79.243	6.208	1888.22	1.478	0.0005049	11.980	5.296
1614.99	1.472	0.0035585	72.217	6.192	1891.07	1.478	0.0003566	8.474	5.288
1619.17	1.472	0.0030471	62.001	6.176	1893.94	1.478	0.0002818	6.708	5.280
1623.38	1.472	0.0022912	46.740	6.160	1896.81	1.479	0.0002757	6.571	5.272
1627.60	1.472	0.0014971	30.620	6.144	1899.70	1.479	0.0003094	7.386	5.264
1631.85	1.473	0.0008532	17.495	6.128	1902.59	1.479	0.0003404	8.139	5.256
1636.13	1.474	0.0006054	12.448	6.112	1905.49	1.479	0.0003795	9.087	5.248
1640.42	1.474	0.0006776	13.968	6.096	1908.40	1.479	0.0003908	9.371	5.240
1644.74	1.475	0.0008182	16.912	6.080	1911.32	1.479	0.0004276	10.271	5.232
1649.08	1.475	0.0008074	16.732	6.064	1914.24	1.480	0.0004650	11.186	5.224
1653.44	1.475	0.0005985	12.436	6.048	1917.18	1.480	0.0006035	14.539	5.216
1666.67	1.476	0.0005508	11.536	6.000	1920.12	1.480	0.0008252	19.910	5.208
1671.12	1.476	0.0007111	14.933	5.984	1923.08	1.480	0.0011183	27.026	5.200
1675.60	1.476	0.0006716	14.142	5.968	1926.04	1.480	0.0015036	36.391	5.192
1680.11	1.476	0.0004311	9.101	5.952	1929.01	1.480	0.0019167	46.462	5.184
1693.77	1.477	0.0004602	9.795	5.904	1931.99	1.480	0.0023248	56.442	5.176
1698.37	1.477	0.0005797	12.373	5.888	1934.99	1.480	0.0026253	63.837	5.168
1703.00	1.477	0.0005249	11.232	5.872	1937.98	1.479	0.0027616	67.254	5.160
1712.33	1.478	0.0005219	11.229	5.840	1940.99	1.479	0.0027959	68.194	5.152
1717.03	1.478	0.0009188	19.824	5.824	1944.01	1.479	0.0026439	64.588	5.144
1721.76	1.478	0.0012990	28.107	5.808	1947.04	1.478	0.0024575	60.128	5.136
1731.30	1.478	0.0012688	27.605	5.776	1950.08	1.478	0.0022436	54.981	5.128
1736.11	1.478	0.0008250	17.999	5.760	1953.13	1.478	0.0019507	47.878	5.120
1740.95	1.478	0.0007069	15.466	5.744	1956.18	1.478	0.0016432	40.394	5.112
1745.81	1.478	0.0006453	14.158	5.728	1959.25	1.478	0.0013353	32.876	5.104
1750.70	1.478	0.0006321	13.906	5.712	1962.32	1.478	0.0009726	23.984	5.096
1765.54	1.479	0.0008529	18.922	5.664	1965.41	1.478	0.0008453	20.877	5.088
1770.54	1.479	0.0011360	25.276	5.648	1968.50	1.478	0.0007359	18.205	5.080
1775.57	1.479	0.0012923	28.834	5.632	1971.61	1.478	0.0006756	16.738	5.072
1780.63	1.479	0.0015114	33.820	5.616	1974.72	1.478	0.0006301	15.637	5.064
1785.71	1.480	0.0019022	42.685	5.600	1977.85	1.478	0.0005997	14.906	5.056
1790.83	1.479	0.0024989	56.236	5.584	1980.98	1.479	0.0005751	14.317	5.048
1795.98	1.479	0.0027466	61.989	5.568	1984.13	1.479	0.0005429	13.538	5.040
1801.15	1.478	0.0023005	52.069	5.552	1987.28	1.479	0.0005063	12.643	5.032
1806.36	1.478	0.0016776	38.080	5.536	1990.45	1.479	0.0004676	11.696	5.024
1811.59	1.478	0.0012181	27.731	5.520	1993.62	1.479	0.0004202	10.528	5.016
1816.86	1.479	0.0010395	23.733	5.504	1996.81	1.479	0.0003772	9.465	5.008
1822.16	1.479	0.0010381	23.771	5.488	2000.00	1.479	0.0003409	8.568	5.000
1827.49	1.479	0.0010409	23.904	5.472	2003.21	1.479	0.0003052	7.682	4.992
1832.85	1.480	0.0011706	26.962	5.456	2006.42	1.479	0.0002777	7.002	4.984
1838.24	1.480	0.0016261	37.562	5.440	2009.65	1.479	0.0002461	6.215	4.976
1843.66	1.480	0.0024489	56.736	5.424	2012.88	1.479	0.0002229	5.639	4.968
1849.11	1.479	0.0032991	76.660	5.408	2016.13	1.479	0.0001951	4.943	4.960
1851.85	1.479	0.0028634	66.634	5.400	2019.39	1.479	0.0001748	4.437	4.952
1854.60	1.479	0.0030250	70.499	5.392	2022.65	1.479	0.0001539	3.911	4.944
1857.36	1.478	0.0030448	71.066	5.384	2025.93	1.479	0.0001335	3.398	4.936
1860.12	1.478	0.0028721	67.135	5.376	2029.22	1.479	0.0001193	3.042	4.928
1862.89	1.478	0.0026064	61.015	5.368	2032.52	1.479	0.0001062	2.713	4.920
1865.67	1.478	0.0022935	53.770	5.360	2035.83	1.479	0.0000959	2.453	4.912
1868.46	1.478	0.0019848	46.602	5.352	2055.92	1.480	0.0000999	2.580	4.864

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2069.54	1.480	0.0000993	2.582	4.832	2327.75	1.481	0.0003554	10.396	4.296
2072.97	1.480	0.0000958	2.495	4.824	2332.09	1.481	0.0003598	10.543	4.288
2076.41	1.480	0.0000892	2.327	4.816	2336.45	1.481	0.0003559	10.450	4.280
2100.84	1.480	0.0000915	2.415	4.760	2340.82	1.481	0.0003508	10.320	4.272
2104.38	1.480	0.0000953	2.521	4.752	2345.22	1.481	0.0003343	9.851	4.264
2107.93	1.480	0.0000960	2.543	4.744	2349.62	1.481	0.0003190	9.419	4.256
2111.49	1.480	0.0000946	2.511	4.736	2354.05	1.481	0.0002934	8.679	4.248
2115.06	1.480	0.0000926	2.460	4.728	2358.49	1.481	0.0002859	8.474	4.240
2136.75	1.480	0.0001019	2.736	4.680	2362.95	1.481	0.0002852	8.468	4.232
2140.41	1.480	0.0001220	3.281	4.672	2367.42	1.481	0.0002867	8.529	4.224
2144.08	1.481	0.0001462	3.939	4.664	2371.92	1.482	0.0002898	8.639	4.216
2147.77	1.481	0.0001741	4.699	4.656	2376.43	1.482	0.0003076	9.186	4.208
2151.46	1.481	0.0001978	5.349	4.648	2380.95	1.482	0.0003269	9.780	4.200
2155.17	1.481	0.0002251	6.096	4.640	2385.50	1.482	0.0003413	10.232	4.192
2158.90	1.481	0.0002346	6.365	4.632	2390.06	1.482	0.0003545	10.648	4.184
2162.63	1.481	0.0002354	6.398	4.624	2394.64	1.482	0.0003674	11.056	4.176
2166.38	1.481	0.0002279	6.205	4.616	2399.23	1.482	0.0003746	11.295	4.168
2170.14	1.481	0.0002134	5.819	4.608	2403.85	1.482	0.0003736	11.284	4.160
2173.91	1.481	0.0002015	5.503	4.600	2408.48	1.482	0.0003650	11.046	4.152
2177.70	1.481	0.0001907	5.219	4.592	2413.13	1.482	0.0003454	10.475	4.144
2181.50	1.481	0.0001811	4.966	4.584	2417.80	1.482	0.0003209	9.750	4.136
2185.32	1.481	0.0001754	4.816	4.576	2422.48	1.482	0.0002973	9.050	4.128
2189.14	1.481	0.0001716	4.722	4.568	2427.18	1.482	0.0002724	8.309	4.120
2192.98	1.481	0.0001653	4.556	4.560	2431.91	1.482	0.0002492	7.616	4.112
2196.84	1.481	0.0001593	4.397	4.552	2436.65	1.482	0.0002362	7.233	4.104
2200.70	1.481	0.0001523	4.213	4.544	2441.41	1.482	0.0002273	6.974	4.096
2204.59	1.481	0.0001470	4.073	4.536	2446.18	1.482	0.0002225	6.839	4.088
2208.48	1.481	0.0001392	3.863	4.528	2450.98	1.482	0.0002193	6.755	4.080
2212.39	1.481	0.0001347	3.745	4.520	2455.80	1.482	0.0002163	6.675	4.072
2216.31	1.481	0.0001330	3.705	4.512	2460.63	1.482	0.0002150	6.648	4.064
2220.25	1.481	0.0001327	3.702	4.504	2465.48	1.482	0.0002120	6.568	4.056
2224.20	1.481	0.0001370	3.828	4.496	2470.36	1.482	0.0002102	6.527	4.048
2228.16	1.481	0.0001491	4.175	4.488	2475.25	1.482	0.0002102	6.540	4.040
2232.14	1.481	0.0001621	4.546	4.480	2480.16	1.482	0.0002096	6.531	4.032
2236.14	1.481	0.0001834	5.152	4.472	2485.09	1.482	0.0002080	6.497	4.024
2240.14	1.481	0.0002074	5.839	4.464	2490.04	1.482	0.0002032	6.359	4.016
2244.17	1.481	0.0002322	6.549	4.456	2495.01	1.482	0.0001995	6.254	4.008
2248.20	1.481	0.0002530	7.148	4.448	2500.00	1.482	0.0001960	6.156	4.000
2252.25	1.481	0.0002710	7.671	4.440	2505.01	1.482	0.0001913	6.022	3.992
2256.32	1.481	0.0002866	8.128	4.432	2510.04	1.482	0.0001863	5.877	3.984
2260.40	1.481	0.0002955	8.393	4.424	2515.09	1.482	0.0001860	5.878	3.976
2264.49	1.481	0.0002991	8.512	4.416	2520.16	1.482	0.0001869	5.920	3.968
2268.60	1.481	0.0002996	8.540	4.408	2525.25	1.482	0.0001901	6.032	3.960
2272.73	1.481	0.0002964	8.466	4.400	2530.36	1.482	0.0001901	6.046	3.952
2276.87	1.481	0.0002898	8.291	4.392	2535.50	1.482	0.0001911	6.088	3.944
2281.02	1.481	0.0002824	8.096	4.384	2540.65	1.482	0.0001929	6.160	3.936
2285.19	1.481	0.0002773	7.962	4.376	2545.83	1.482	0.0001960	6.271	3.928
2289.38	1.481	0.0002834	8.154	4.368	2551.02	1.482	0.0002070	6.637	3.920
2293.58	1.481	0.0002864	8.255	4.360	2556.24	1.482	0.0002255	7.245	3.912
2297.79	1.481	0.0002945	8.502	4.352	2561.48	1.482	0.0002485	7.999	3.904
2302.03	1.481	0.0002968	8.587	4.344	2566.74	1.482	0.0002810	9.063	3.896
2306.27	1.481	0.0003096	8.973	4.336	2572.02	1.482	0.0003160	10.214	3.888
2310.54	1.481	0.0003234	9.390	4.328	2577.32	1.482	0.0003414	11.059	3.880
2314.82	1.481	0.0003328	9.681	4.320	2582.65	1.482	0.0003533	11.467	3.872
2319.11	1.481	0.0003430	9.996	4.312	2587.99	1.482	0.0003510	11.414	3.864
2323.42	1.481	0.0003514	10.260	4.304	2593.36	1.482	0.0003406	11.101	3.856

TOLUENE					TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns	frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
2598.75	1.482	0.0003227	10.537	3.848	2948.11	1.484	0.0056867	210.674	3.392
2604.17	1.482	0.0003008	9.844	3.840	2955.08	1.483	0.0052863	196.303	3.384
2609.60	1.482	0.0002795	9.165	3.832	2962.09	1.483	0.0051406	191.349	3.376
2615.06	1.483	0.0002667	8.764	3.824	2969.12	1.484	0.0049825	185.904	3.368
2620.55	1.483	0.0002542	8.370	3.816	2976.19	1.484	0.0050313	188.169	3.360
2626.05	1.483	0.0002410	7.953	3.808	2983.29	1.484	0.0053165	199.311	3.352
2631.58	1.483	0.0002292	7.580	3.800	2990.43	1.485	0.0058880	221.264	3.344
2637.13	1.483	0.0002184	7.236	3.792	2997.60	1.485	0.0066955	252.212	3.336
2642.71	1.483	0.0002103	6.985	3.784	3004.81	1.484	0.0075893	286.570	3.328
2648.31	1.483	0.0002024	6.737	3.776	3012.05	1.484	0.0087047	329.478	3.320
2653.93	1.483	0.0001928	6.429	3.768	3019.32	1.483	0.0094100	357.033	3.312
2659.57	1.483	0.0001887	6.307	3.760	3026.63	1.481	0.0095946	364.918	3.304
2665.25	1.483	0.0001882	6.304	3.752	3033.98	1.480	0.0095872	365.523	3.296
2670.94	1.483	0.0001880	6.309	3.744	3041.36	1.479	0.0093586	357.675	3.288
2676.66	1.483	0.0001869	6.288	3.736	3048.78	1.478	0.0088052	337.347	3.280
2682.40	1.483	0.0001863	6.280	3.728	3056.24	1.477	0.0078674	302.154	3.272
2688.17	1.483	0.0002065	6.975	3.720	3063.73	1.476	0.0069090	265.996	3.264
2693.97	1.483	0.0002409	8.157	3.712	3071.25	1.475	0.0059541	229.795	3.256
2699.78	1.483	0.0002799	9.496	3.704	3078.82	1.475	0.0046322	179.218	3.248
2705.63	1.483	0.0003323	11.297	3.696	3086.42	1.475	0.0035125	136.232	3.240
2711.50	1.483	0.0003957	13.483	3.688	3094.06	1.475	0.0019902	77.380	3.232
2717.39	1.483	0.0004591	15.678	3.680	3101.74	1.476	0.0015418	60.094	3.224
2723.31	1.484	0.0004982	17.049	3.672	3109.45	1.477	0.0011717	45.785	3.216
2729.26	1.484	0.0005051	17.322	3.664	3117.21	1.477	0.0008717	34.147	3.208
2735.23	1.484	0.0004808	16.525	3.656	3125.00	1.477	0.0006860	26.937	3.200
2741.23	1.484	0.0004472	15.405	3.648	3132.83	1.478	0.0005194	20.447	3.192
2747.25	1.484	0.0004161	14.364	3.640	3140.70	1.478	0.0004438	17.515	3.184
2753.30	1.484	0.0003951	13.669	3.632	3148.62	1.478	0.0003984	15.765	3.176
2759.38	1.484	0.0003903	13.535	3.624	3156.57	1.479	0.0003458	13.717	3.168
2765.49	1.484	0.0004040	14.041	3.616	3164.56	1.479	0.0003047	12.119	3.160
2771.62	1.484	0.0004278	14.899	3.608	3172.59	1.479	0.0002654	10.581	3.152
2777.78	1.484	0.0004677	16.327	3.600	3180.66	1.479	0.0002338	9.346	3.144
2790.18	1.485	0.0005083	17.823	3.584	3188.78	1.479	0.0002070	8.296	3.136
2796.42	1.485	0.0006051	21.262	3.576	3196.93	1.479	0.0001811	7.274	3.128
2802.69	1.485	0.0007511	26.453	3.568	3205.13	1.480	0.0001612	6.492	3.120
2808.99	1.485	0.0009289	32.788	3.560	3213.37	1.480	0.0001447	5.843	3.112
2815.32	1.485	0.0011695	41.376	3.552	3221.65	1.480	0.0001305	5.283	3.104
2821.67	1.485	0.0014068	49.881	3.544	3229.97	1.480	0.0001227	4.979	3.096
2828.05	1.486	0.0017314	61.531	3.536	3238.34	1.480	0.0001142	4.647	3.088
2834.47	1.486	0.0021367	76.108	3.528	3246.75	1.480	0.0001098	4.481	3.080
2840.91	1.485	0.0026018	92.883	3.520	3255.21	1.480	0.0001032	4.220	3.072
2847.38	1.485	0.0016465	58.914	3.512	3263.71	1.480	0.0001027	4.211	3.064
2853.88	1.486	0.0022895	82.107	3.504	3272.25	1.480	0.0000961	3.950	3.056
2860.41	1.485	0.0026611	95.655	3.496	3280.84	1.480	0.0000943	3.887	3.048
2866.97	1.485	0.0026756	96.393	3.488	3289.47	1.480	0.0000910	3.763	3.040
2873.56	1.485	0.0027015	97.552	3.480	3298.15	1.481	0.0000880	3.647	3.032
2880.18	1.485	0.0026972	97.620	3.472	3306.88	1.481	0.0000835	3.469	3.024
2886.84	1.486	0.0027943	101.370	3.464	3315.65	1.481	0.0000814	3.390	3.016
2893.52	1.486	0.0031828	115.729	3.456	3324.47	1.481	0.0000762	3.182	3.008
2900.23	1.486	0.0038698	141.035	3.448	3333.33	1.481	0.0000747	3.128	3.000
2906.98	1.486	0.0045588	166.533	3.440	3342.25	1.481	0.0000715	3.003	2.992
2913.75	1.486	0.0052927	193.792	3.432	3351.21	1.481	0.0000706	2.973	2.984
2920.56	1.486	0.0056591	207.692	3.424	3360.22	1.481	0.0000687	2.900	2.976
2927.40	1.485	0.0059888	220.307	3.416	3369.27	1.481	0.0000697	2.952	2.968
2934.27	1.484	0.0059257	218.501	3.408	3378.38	1.481	0.0000692	2.938	2.960
2941.18	1.484	0.0058384	215.787	3.400	3387.53	1.481	0.0000676	2.878	2.952

TOLUENE				
frequency cm ⁻¹	n	k	alpha cm ⁻¹	wavelength microns
3396.74	1.481	0.0000676	2.885	2.944
3406.00	1.481	0.0000656	2.806	2.936
3415.30	1.481	0.0000642	2.756	2.928
3531.07	1.482	0.0000591	2.624	2.832
3541.08	1.482	0.0000629	2.799	2.824
3551.14	1.482	0.0000697	3.113	2.816
3561.25	1.482	0.0000760	3.402	2.808
3571.43	1.482	0.0000845	3.792	2.800
3581.66	1.482	0.0000950	4.274	2.792
3591.95	1.482	0.0001070	4.828	2.784
3602.31	1.482	0.0001210	5.477	2.776
3612.72	1.482	0.0001307	5.933	2.768
3623.19	1.482	0.0001392	6.339	2.760
3633.72	1.482	0.0001426	6.511	2.752
3644.32	1.482	0.0001425	6.527	2.744
3654.97	1.482	0.0001371	6.295	2.736
3665.69	1.482	0.0001306	6.017	2.728
3676.47	1.482	0.0001226	5.665	2.720
3687.32	1.482	0.0001150	5.330	2.712
3698.23	1.482	0.0001095	5.087	2.704
3709.20	1.482	0.0001046	4.876	2.696
3720.24	1.482	0.0001044	4.882	2.688
3731.34	1.482	0.0001040	4.876	2.680
3742.52	1.482	0.0001081	5.083	2.672
3753.75	1.482	0.0001161	5.476	2.664
3765.06	1.482	0.0001227	5.803	2.656
3776.44	1.482	0.0001347	6.394	2.648
3787.88	1.482	0.0001457	6.934	2.640
3799.39	1.482	0.0001576	7.526	2.632
3810.98	1.482	0.0001735	8.311	2.624
3822.63	1.482	0.0001812	8.705	2.616
3834.36	1.482	0.0001883	9.072	2.608
3846.15	1.482	0.0001920	9.282	2.600
3858.03	1.482	0.0001904	9.229	2.592
3869.97	1.482	0.0001953	9.497	2.584
3881.99	1.482	0.0001880	9.172	2.576
3894.08	1.482	0.0001884	9.218	2.568
3906.25	1.482	0.0001879	9.223	2.560
4059.12	1.482	0.0006920	35.297	2.464
4174.64	1.482	0.0001838	9.644	2.395
4247.17	1.482	0.0003318	17.707	2.355
4347.88	1.482	0.0002890	15.789	2.300
4400.05	1.482	0.0001895	10.476	2.273
4480.70	1.483	0.0000681	3.836	2.232
4564.36	1.483	0.0001826	10.476	2.191
4621.88	1.483	0.0002401	13.946	2.164
4867.27	1.483	0.0000109	0.667	2.055
5000.00	1.483	0.0000106	0.667	2.000

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